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THE MOUNTAIN ANTS OF WESTERN NORTH AMERICA.

By William Morton Wheeler.

THE MOUNTAIN ANTS OF WESTERN NORTH AMERICA.[1]

BY WILLIAM MORTON WHEELER.

Received September 12, 1916.

THE study of several collections of ants received from Professors J. C. Bradley, C. F. Baker, T. D. A. Cockerell, C. C. Adams, S. J. Hunter, Dr. W. M. Mann, Dr. R. V. Chamberlin, Mr. E. J. Oslar and others and of my own collections made during several seasons in Colorado, New Mexico, Texas, Arizona and Southern California, and especially during the summer of 1915 in the Yosemite Valley and at Lake Tahoe, California and in the Canadian Rockies, enables me to give a much more consistent and comprehensive account of the distribution of the Formicidae .of Western North America than was possible heretofore. These collections represent two distinct faunas, one of which belongs to Merriam's Lower and Upper Sonoran Zones and comprises species of several neotropical and tropicopolitan genera and subgenera, while the other, occurring at higher elevations belongs to Merriam's Transition and Canadian Zones and is represented by species of the genera *Monomorium, Solenopsis, Myrmecina, Myrmica, Leptothorax, Aphaenogaster, Stenamma, Liometopum, Tapinoma, Prenolepis s. str., Lasius, Formica, Polyergus* and a few subgenera of *Camponotus* (*Camponotus s. str. and Myrmoturba*). There is some overlapping of the Sonoran and mountain faunas due to the ascent of such forms as *Pogonomyrmex occidentalis, Myrmecocystus mexicanus* and a few species of *Crematogaster, Pheidole* and *Solenopsis* into the Transition Zone and the descent of a few species of *Camponotus s. str., Myrmica* and *Formica* into the Sonoran Zones. In the following pages I have listed the known forms belonging to the Transition and Canadian Zones of Western North America and have added descriptions of 32 new forms (three species, twelve subspecies and seventeen varieties) which I have been able to recognize among the recently collected material. I have not included any of our Ponerinae in the list, because the distribution of the species of *Ponera*, *Stigmatomma*, *Proceratium* and *Sysphincta*, with the exception of *Ponera coarctata* subsp. *pennsylvanica*, is imperfectly known, and because I have no new data for publication. The ants of the genera *Proceratium* and *Sysphincta* are very rare and seem to belong to the Upper and Lower Austral Zones, but they will probably be discovered in the Western States. I have, in fact, seen a male specimen which seems to belong to one of these genera, from California. *Ponera pennsylvanica* is confined to the Eastern and Central States, Ontario and Nova Scotia. The genus is represented in the Western and Southern States by at least two closely allied species (*P. trigona* var. *opacior* and *P. opaciceps*), whose precise distribution is still unknown.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 118.

The great importance of the ants in the study of geographical distribution has not been overlooked by students of this fascinating subject. These insects are, indeed, specially fitted for the mapping of geographical areas, for several reasons. They are not, like many other groups of insects, absolutely dependent on specific food-plants, their colonies are stable and stationary entities, chained to the soil or to certain general plant associations, and they are exceedingly sensitive to climatic and other environmental influences as shown by the extraordinary development of geographical races (subspecies) and varieties in practically all the species of extensive range. A few authors have attempted to minimize these peculiarities on the ground that the marriage-flight of male and female ants must permit of a wide dissemination of the species. It is true that many species of ants have a very wide range, e. g. *Formica fusca*, which is circumpolar and *Camponotus maculatus* which is cosmopolitan, but this is, in all probability, the result of great geologic age, and while we must admit that the nuptial flight of the female ant is practically the only means of rapidly disseminating the species, it is easy to exaggerate its importance. It is natural to suppose that small flying insects, like many female ants, must be carried long distances by air-currents, and these females, when fecundated, are, of course, so many potential colonies. But such observations as can be made in the field do not support this supposition. Most female ants are heavy-bodied and have feeble powers of flight. Moreover, the time during which they can use their wings, especially after fecundation, is limited to a few hours at most. The wing muscles very soon begin to degenerate and compel the insects to descend, abandon their organs of flight and become as completely terrestrial as the workers. During marriage flights female ants are therefore usually observed to return in great numbers to the ground at no great distance from their parental nests.

The height to which ants are able to ascend on their nuptial flights will be ascertained only when some of our young myrmecologists become aviators. We know that winged ants are often carried to high mountain peaks. Forel (1874) records the occurrence of males and females of *Formica rufa* and *pratensis* on the perpetual snows of Alpine glaciers, and Mrs. Slosson sent me several male and female ants of different genera from the summit of Mt. Washington, N. H. (Wheeler 1905). I have myself taken similar specimens on the summits of other peaks in the White Mountains. But, as Forel has shown, female ants never succeed in establishing colonies at these altitudes. They are merely transported to the summits by the air-currents which are known to ascend mountain slopes during the day-time and to carry up great numbers of insects of all orders. Unless, therefore, such females were able to descend on the opposite slopes,— and this is probably of very rare occurrence — high mountain ranges must constitute barriers as effective as are considerable bodies of water or deserts to the distribution of most ants. I am convinced that the Sierra Nevada in California is such a barrier to many forms common on the Pacific Coast and in Europe the Alps certainly act as a similar barrier to many species common in Italy and Central Europe.

For the purpose of bringing before the reader as clearly as possible the results of my study of the ants of the Transition and Canadian Zones, I have cited the various species, subspecies and varieties from the Coast Range of California, the Sierra-Cascade Ranges, the Rocky Mountains and the portion of North America east of these ranges in four columns in the accompanying Tables I to IX (pp. 464 to 481). As might be expected, the great ranges of the Rocky Mountains, from British America to Mexico, show the greatest number and diversify of forms. The Eastern portion of North America has, with the exception of a certain number of holarctic and neotropical species, a fauna peculiar to itself, and the Sierras and Californian Coast each possesses peculiar elements, though also possessing many forms in common with the Rocky Mountains. One is struck in the tables by the meagerness of the two Californian mountain faunas. This might be attributed to their much smaller territory, but such can hardly be a complete explanation, for ant-colonies in California, even those of the more dominant species, are much less numerous than they are in the Rocky Mountains and Eastern States. I believe that the difference is due to the peculiar annual distribution of temperature and moisture in California. The ants of the Transition and Boreal Zones require a considerable amount of humidity and warmth during their breeding season. These conditions are not realized simultaneously in California, where the rainy season comes during the winter and the summer is rainless except in the high Sierras. The more perfect adaptation of the species of the Sonoran zones to a smaller amount of moisture and to winter temperatures not sufficiently low to inhibit completely the activities of the worker ants, probably accounts for the greater number of species and colonies at lower altitudes in Southern California, where the conditions are much like those of Arizona. Even moderately low temperatures, when coupled with considerable humidity, a condition which prevails in California during the winter months, is very unfavorable to ants, and when such conditions are most accentuated, the ant-fauna is reduced to a mere remnant, although the vegetation, if the temperature is not too low, may be luxuriant. This is the case in New Zealand where I sometimes searched in vain for an ant-colony in forests whose luxuriance rivalled those of the tropics. But we have a striking example of the depressing effects of cold and moisture on ant-life much nearer home. The cool Selkirk Mts. of British Columbia have an abundant supply of moisture and an unusually rich flora, but their ant-fauna is reduced to a few boreal species. The adjacent Canadian Rockies, however, though in the same latitude, are less humid and have a poorer flora, but their ant-fauna is decidedly richer in species and colonies.

In mountain regions slope exposure in its relation to insolation is a very important factor in the local distribution of ants, but it is impossible at present to give more than a general statement in regard to this matter. Northern slopes in the northern hemisphere are usually, for very obvious reasons, almost or quite destitute of ants. In regard to the other slopes my observations in the Alps of Switzerland and the mountains of the United States, British America, Mexico and Central America confirm those of Forel in the Alps and the mountains of North Carolina. He finds that ants prefer the eastern and southern slopes as these are the situations in which they have the longest day for their activities during the breeding season, since they are early awakened by a sufficiently high temperature of the soil and air from the lethargy induced by the chill night hours, and even though the slope may be in shade during the afternoon the warmth is sufficient to sustain their activities till sun-set. On western slopes, however, the morning hours are too cool and are therefore practically lost to the ants, whereas the afternoon hours are too warm.

This preference of our northern ants for eastern and southern slopes is further confirmed by the shape of the nest and the position of the nest-entrance of certain species. This matter was considered in my ant-book (1910, p. 205) in the following passage: "I have already called attention to the constant position of the nest opening at the base of the southern or eastern slope of the mounds of *Pogonomyrmex occidentalis*. Huber says that the yellow ants (*Lasius flavus*) of Switzerland "serve as compasses to the mountaineers when they are enveloped in dense fogs or have lost their way at night; for the reason that the nests, which in the mountains are much more numerous and higher than elsewhere, take on an elongated, almost regular form. Their direction is constantly from east to west. Their summits and more precipitous slopes are turned towards the winter sunrise, their longer slopes in the opposite direction." These remarks of Huber have been recently confirmed by Tissot (Wasmann 1907) and Linder (1908). The latter has shown that the elongate shape of the mounds is due to the fact that the ants keep extending them in an easterly direction in such a manner that only the extreme easterly, highest and most precipitous portions are inhabited by the insects. I have observed a similar and equally striking orientation of the mounds of *Formica argentata* [*fusca* var. *argentea*] in the subalpine meadows of Colorado." In the southern hemisphere, as we should expect, the ants prefer the northern and eastern slopes of the mountains. I found many striking instances of this preference while collecting in the mountains of New Zealand, New South Wales and Queensland.

Merriam and his collaborators in their studies of the floras and faunas of the mountains of western North America have published interesting observations which deserve consideration since they have a bearing on the distribution of the Formicidae though they show that these insects would hardly suffice to determine the boundaries of the various life-zones on mountain slopes. In his work on Mt. Shasta, Merrian (1899) says: "The influence of slope exposure on the faunas and floras of mountain regions is profound. Measured by a scale of altitudes it amounts on ordinary slopes to nearly a thousand feet and on steep slopes is still more marked. Thus on mountains it is usual for plants and animals of particular species to occur on warm southwesterly slopes at elevations 800 to 1000 feet higher than on cool northeasterly slopes.— similarly on north and south ridges, the fauna and floras of the warm west slopes often belong to lower zones than those of equal elevations on the cool east slopes." Merriam had previously shown the existence of very similar conditions in a very different region, the San Francisco Mountains of Arizona (1890). There he found the normal difference in altitude of the same zone on the southwest and northeast slopes to be about 900 feet. After giving numerous examples of this altitudinal distribution on Mt. Shasta, he calls attention to other factors, besides those of insolation, which influence the range of plants and animals: "It is well-known that in ordinary calm weather the air-currents on mountain sides and in deep canyons ascend by day and descend by night. The ascending currents are warm, the descending currents cold. The night current, being in the main free from local influences that affect its temperature, must exert an essentially equal affect on all sides of a mountain; but the temperature of the ascending day current, being constantly exposed to and in fact created by the influence of the sun, must vary enormously on different slopes. The activity and effectiveness of this current increase with the steepness of the slope and the directness of its exposure to the afternoon sun. Hence the hottest normal slopes—those that face the sun at nearly a right angle during the hottest part of the day — are rendered still more potent by increased steepness, the direct exposure of the sun keeping up the supply of heat while the steepness of the slope accelerates the rate of movement of the diurnal ascending current, carrying the heated air upward a very great distance before it has time to be cooled to the general temperature of the stratum it penetrates. Thus it is that species characteristic of the Transition zone on Shasta — species which on normal southwesternly slopes attain their upper limits at an altitude of 5500 to 5700 feet — are in favorable places enabled to live at elevations of 7900 or even 8000 feet, considerably more than 2000 feet above their normal limits."

Every observer in the field must have been impressed with the fact that steepness of slope is an important factor in the local distribution of mountain ants. These insects always greatly prefer the more gradual slopes and alpine meadows, probably because the soil of such places retains a more abundant and more equable supply of moisture and because their surfaces are much less exposed to rapid evaporation both from direct insolation and from air-currents. All of these ecological factors demand much more careful study.

It is, of course, well known that the delimitation of the various life-zones in mountain regions depends not only on slope-exposure but also on latitude. That the upper limit of the zones descends in more northern and ascends in more southern latitudes even within the confines of a single one of our western states is well shown in the following table from Cary's "Biological Survey of Colorado" (1911):

Zone	North Colorado		Southern Colorado	
	Northeast exposure	Southwest exposure	Northeast exposure	Southwest exposure
	Feet	Feet	Feet	
Upper Soronan	—— to 5600	—— to 6500	—— to 6500	—— to 7800
Transition	5600 to 7500	6500 to 8200	6500 to 8000	7800 to 9000
Canadian	7500 to 10000	8200 to 10400	8000 to 10500	9000 to 11000
Hudsonian	10000 to 10900	10400 to 11600	10500 to 11200	11000 to 12000
Arctic-Alpine	10900 to ——	11600 to ——	11200 to ——	12000 to ——

In his "Life Zones and Crop Zones of New Mexico, Bailey (1913) gives the upper boundary of the Upper Sonoran as 5000–7000 or even 8000 ft., the boundaries of the Transition as extending from 7000 to 8500 ft. on northeastern and 8000 to 9500 on southwestern slopes, of the Canadian as from 8500 to 11,000 and on warm slopes from 9500 to 12,000, of the Hudsonian from 11,000 to 12,000 on northeastern and 12,000 to 13,000 on southwestern slopes, the Arctic-Alpine on the Sangre de Cristo Range as all above 12,000 ft. on the coldest slopes, and on especially steep slopes as all above 11,500 ft.; on the warmest slopes as all above 13,000 ft. or on very gradual slopes all above 12,500 ft. In Arizona the boundaries of the life-zones ascend somewhat higher, as indicated by the following altitudes from Merriam's work (1890) on the San Francisco Mountains (southwest slopes): Lower Sonoran 4000–6000 ft., Upper Sonoran 6000–7000 ft., Transition 7000–8200 ft., Canadian 8200–9200 ft., Hudsonian 9200–10,500 ft., Arctic-Alpine 10,500–11,500 ft. In the Chisos, Davis and Guadeloupe Mountains of Western Texas, according to Bailey (1905) the Transition Zone extends from about 6000 ft. on northeast slopes to the top of the ranges (8000–9500 ft.). In Mexico the upper boundary of the Transition must be even higher. North of Colorado the zonal boundaries descend rapidly till in the latitude of Vancouver and Maine the Canadian zone, which extends across the continent, is at sea-level, so that we find at this level such forms as *Camponotus whymperi, modoc,* and *laevigatus,* the two latter of which do not descend below 4000 to 6000 ft. in the Sierras, while *whymperi* and *laevigatus* are not known from elevations under 7000 to 8000 ft. in Colorado. On the other

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Monomorium	**Monomorium**
	minimum
minimum subsp. *ergatogyna*	
Solenopsis	**Solenopsis**
molesta var. validiuscula	
Myrmecina	**Myrmecina**
Myrmica	**Myrmica**
	brevinodis var. sulcinodoides
	var. subalpina
	scabrinodis subsp. schencki var. *tahoënsis*
	bradleyi

I.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Monomorium	**Monomorium**
minimum	minimum
subsp. *compressum*	
subsp. *cyaneum*	
Solenopsis	**Solenopsis**
molesta	molesta
var. validiuscula	
var. *castanea*	
Myrmecina	**Myrmecina**
graminicola subsp. americana	graminicola subsp. americana
var. brevispinosa	var. brevispinosa
subsp. *texana*	
Myrmica	**Myrmica**
brevinodis	
var. sulcinodoides	brevinodis var. *canadensis*
var. *decedens*	
var. *brevispinosa*	
var. subalpina	
var. *frigida*	
scabrinodis subsp. *lobicornis* var. *glacialis*	scabrinodes var. *sabuleti*
	var. *fracticornis*
	var. *detritinodis*
scabrinodis subsp. schencki var. *monticola*	scabrinodis subsp. schencki var. *emeryana*
mexicana	*punctiventris*
	var. *pinetorum*
mutica	*rubra* subsp. *laevinodis* var. *bruesi*
aldrichi	subsp. *neolaevinodis*
hunteri	subsp. *champlaini*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Leptothorax	**Leptothorax**
andrei	
eldoradensis	
nitens var. *heathi*	nitens
var. *mariposa*	
var. *occidentalis*	
	nevadensis
	subsp. *rudis*
	rugatulus var. *mediorufus*
	acervorum subsp. canadensis var. *calderoni*
Symmyrmica	**Symmyrmica**
Harpagoxenus	**Harpagoxenus**

II.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Leptothorax	**Leptothorax**
schmitti	
neomexicanus	
nitens	
tricarinatus	
melanderi	
furunculus	*longispinosus*
mexicanus	*fortinodis*
terrigena	*schaumi*
texanus	texanus var. *davisi*
obturator	
rugatulus	*curvispinosus*
var. *cockerelli*	subsp. *ambiguus*
subsp. *annectens*	
subsp. *brunnescens*	
muscorum var. *sordidus*	
var. *septentrionalis*	
acervorum subsp. canadensis	acervorum subsp. canadensis
var. convivialis	var. convivialis
var. *yankee*	
subsp. *crassipilis*	
emersoni subsp. *glacialis*	*emersoni*
subsp. *hirtipilis*	
hirticornis subsp. *formidolosus*	*hirticornis*
provancheri	
Symmyrmica	**Symmyrmica**
chamberlini	
Harpagoxenus	**Harpagoxenus**
	americanus

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Stenamma	**Stenamma**
brevicorne subsp. *heathi*	
subsp. *sequoiarum*	
nearcticum	
Aphaenogaster	**Aphaenogaster**
subterranea subsp. occidentalis	subterranea subsp. occidentalis
	subsp. valida var. *manni*
patruelis	
var. *bakeri*	
var. *carbonaria*	
mutica	
Liometopum	**Liometopum**
occidentale	apiculatum
apiculatum subsp. luctuosum	

III.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Stenamma	**Stenamma**
	brevicorne
brevicorne subsp. diecki	subsp. diecki
	var. *impressum*
	subsp. *impar*
	subsp. *schmitti*
manni	
Aphaenogaster	**Aphaenogaster**
subterranea subsp. occidentalis	*fulva*
subsp. *valida*	subsp. *aquia*
subsp. *borealis*	var. *picea*
fulva subsp. aquia var. rudis	var. rudis
var. *azteca*	
uinta	
texana	
var. *furvescens*	texana var. *carolinensis*
	mariae
mutica	*tennesseensis*
	var. *ecalcarata*
	treatae
	subsp. *wheeleri*
	lamellidens
Liometopum	**Liometopum**
apiculatum	
subsp. luctuosum	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Tapinoma	**Tapinoma**
sessile	sessile
Prenolepis	**Prenolepis**
imparis	imparis
Lasius	**Lasius**
niger var. sitkaënsis	niger var. sitkaënsis
var. neoniger	var. neoniger
	subsp. alienus var. americanus
	brevicornis subsp. *microps*
	flavus subsp. claripennis
	umbratus subsp. subumbratus
	humilis
	latipes
interjectus subsp. *californicus*	

IV.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Tapinoma	**Tapinoma**
sessile	sessile
Prenolepis	**Prenolepis**
imparis	imparis
	var. *testacea*
	var. *parva*
Lasius	**Lasius**
niger var. sitkaënsis	niger var. sitkaënsis
var. neoniger	var. neoniger
subsp. alienus var. americanus	subsp. alienus var. americanus
brevicornis	brevicornis
flavus subsp. nearcticus	flavus subsp. nearcticus
subsp. claripennis	
umbratus subsp. subumbratus	umbratus subsp. subumbratus
subsp. mixtus var. aphidicola	subsp. mixtus var. aphidicola
subsp. *vestitus*	subsp. *speculiventris*
	subsp. *minutus*
latipes	latipes
occidentalis	
murphyi	murphyi
interjectus	interjectus
subsp. *coloradensis*	
subsp. *arizonicus*	
subsp. *mexicanus*	
claviger	claviger
	subsp. *subglaber*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
sanguinea subsp. subnuda	sanguinea subsp. subnuda
	manni
	rufa subsp. obscuripes
	var. melanotica
truncicola subsp. integroides	truncicola subsp. integroides
var. *subfasciata*	var. *tahoënsis*
	var. *propinqua*
	var. haemorrhoidalis
subsp. integra var. subcaviceps	subsp. integra var. subcaviceps
	oreas var. comptula

V.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
sanguinea subsp. subnuda	sanguinea subsp. subnuda
subsp. puberula	subsp. puberula
	subsp. *subintegra*
	var. *gilvescens*
subsp. *obtusopilosa*	subsp. *rubicunda*
	var. *sublucida*
munda	subsp. *aserva*
var. *alticola*	*pergandei*
manni	
perpilosa	
bradleyi	
rufa subsp. obscuripes	
var. melanotica	rufa subsp. obscuripes var. melanotica
truncicola subsp. integroides var. *coloradensis*	
var. *ravida*	
var. haemorrhoidalis	
subsp. *mucescens*	
subsp. obscuriventris var. *aggerans*	truncicola subsp. *obscuriventris*
	var. *gymnomma*
subsp. integra	subsp. integra
foreliana	*ferocula*
ciliata	
comata	
criniventris	
oreas	
var. comptula	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
	microgyna subsp. rasilis
	var. *pinetorum*
	subsp. *californica*
	var. *hybrida*
	nevadensis
fusca	fusca
	var. marcida
	var. subaenescens
var. argentea	var. argentea
var. neorufibarbis	var. neorufibarbis
	var. *blanda*
	subsp. pruinosa var. *lutescens*
rufibarbis var. *occidua*	

VI.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
dakotensis	
var. *montigena*	dakotensis var. *speculiventris*
var. *saturata*	
microgyna	microgyna subsp. *scitula*
var. *recidiva*	*difficilis*
subsp. rasilis	var. *consocians*
var. *spicata*	*impexa*
var. *pullula*	*nepticula*
var. *nahua*	*morsei*
whymperi	
var. *alpina*	whymperi var. *adamsi*
exsectoides var. *hesperia*	*exsectoides*
subsp. *opaciventris*	var. *davisi*
ulkei	ulkei
	var. *hebescens*
fusca	fusca
var. marcida	
var. subsericea	var. subsericea
var. subaenescens	var. subaenescens
var. argentea	var. argentea
var. *gelida*	var. *algida*
var. neorufibarbis	
var. *neoclara*	
subsp. *pruinosa*	
rufibarbis var. *gnava*	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
cinerea var. neocinerea	
var. *lepida*	
subsp. *pilicornis*	
	sibylla
subpolita	
var. camponoticeps	subpolita var. camponoticeps
	neogagates
neogagates subsp. lasioides var. vetula	subsp. lasioides var. vetula
Polyergus	**Polyergus**
rufescens subsp. breviceps	rufescens subsp. breviceps
var. *umbratus*	
subsp. *laeviceps*	

VII.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
cinerea var. neocinerea	cinerea var. neocinerea
var. *altipetens*	var. *rutilans*
var. *canadensis*	
montana	
hewitti	
subcyanea	
subpolita var. *ficticia*	
neogagates	neogagates
var. *morbida*	var. *vinculans*
subsp. lasioides	subsp. lasioides
var. vetula	var. vetula
limata	
	pallidefulva
	var. *succinea*
	subsp. *schaufussi*
	var. *dolosa*
pallidefulva subsp. schaufussi var. incerta	var. incerta
subsp. nitidiventris	subsp. nitidiventris
var. fuscata	var. fuscata
moki	
Polyergus	**Polyergus**
rufescens subsp. breviceps	rufescens subsp. breviceps
var. *montezuma*	
var. *fusciventris*	
subsp. *mexicanus*	
subsp. bicolor	subsp. bicolor
lucidus subsp. *montivagus*	*lucidus*

Table

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Camponotus	**Camponotus**
laevigatus	laevigatus
	herculeanus var. modoc
	subsp. ligniperda var. noveboracensis
hyatti	
var. *bakeri*	
anthrax	
fallax var. nearcticus	fallax var. nearcticus
	var. minutus
subsp. subbarbatus	
subsp. discolor var. clarithorax	subsp. discolor var. clarithorax

VIII.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Camponotus	**Camponotus**
laevigatus	
herculeanus, var. modoc	
var. whymperi	herculeanus var. whymperi
	subsp. *pennsylvanicus*
	var. *ferrugineus*
	var. *mahican*
subsp. ligniperda var. noveboracensis	subsp. ligniperda var. noveboracensis
	var. *rubens*
schaefferi	*castaneus*
texanus	subsp. *americanus*
sayi	
fallax var. nearcticus	fallax var. nearcticus
var. minutus	var. minutus
var. decipiens	var. decipiens
	var. *tanquaryi*
	var. *pardus*
subsp. *rasilis*	
var. *pavidus*	
	subsp. subbarbatus
	var. *paucipilis*
subsp. discolor	subsp. discolor
var. clarithorax	var. clarithorax
	var. *cnemidatus*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Camponotus	**Camponotus**
maculatus subsp. vicinus	maculatus subsp. vicinus
var. plorabilis	
var. luteangulus	
var. semitestaceus	var. semitestaceus
var. nitidiventris	
var. *maritimus*	
var. infernalis	var. infernalis
subsp. *dumetorum*	
subsp. *maccooki*	
fumidus var. *fragilis*	
ocreatus	
mina	
yogi	

IX.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Camponotus	**Camponotus**
maculatus subsp. vicinus	
var. plorabilis	
var. luteangulus	
var. nitidiventris	
var. infernalis	
subsp. *sansabeanus*	
var. *torrefactus*	
subsp. *bulimosus*	
fumidus var. *festinatus*	
var. *spurcus*	
vafer	
acutirostris	
var. *clarigaster*	
ocreatus subsp. *primipilaris*	
mina subsp. *zuni*	
bruesi	
ulcerosus	
pylartes	*impressus*
var. *hunteri*	
abditus var. *etiolatus*	

hand, in the Huachuca Mountains of Arizona such neotropical forms as species of *Eciton, Odontomachus, Pheidole,* etc. are abundant at altitudes of 4000 to 6000 ft.[2]

Before considering the historical problems suggested by the ant-faunas of the four regions of the tables, it will be advisable to analyze them more closely. The total number of forms recorded for all the regions is 422 distributed as follows:

A	B	C	D
58 or 13.7%	60 or 14.2%	180 or 42.6%	124 or 29.4%

In reality the total number of *different* forms is only 311. If we count only the forms peculiar, endemic, or precinctive to each region (printed in italics in the tables) we have the following:

	A	B	C	D	Totals
Species	11	5	47	25	88
Subspecies	7	3	27	18	55
Varieties	11	10	38	32	91
	29	18	112	75	234

There are therefore 77 forms common to two or more of the regions. This would yield the following percentages for the given groups:

A	B	C	D	Common
9.3%	5.8%	36.0%	24.1%	24.8%

The total number of endemic forms in the western fauna (A + B + C) is 159 or 68%, whereas the 75 eastern forms represent only 32%. The number of forms in common gives a good index of the affinities of the different regions, and may be tabulated as follows:

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[2] In his interesting paper on the insects of Custer County, Colorado, Cockerell (1893) does not accept Merriam's terminology for the life-zones of that region. He distinguishes three zones, a "subalpine," up to about 6500 ft., a "mid-alpine" between 6500 and 10,000 ft. and a "high-alpine" zone above the latter elevation, and correlates these with Merriam's zones in the statement that "an analysis of the insects of the Colorado Mountains shows that the high-alpine and mid-alpine elements, though sufficiently distinct, are both essentially boreal. If we follow Dr. Merriam's arrangement, it appears that the high-alpine is truly boreal, while the mid-alpine belongs to the transition region, containing a considerable number of strictly American types. The subalpine, on the other hand is southern or Sonoran."

Faunas of the Four Regions	Species in common	Subspecies in common	Varieties in common	Total number of forms in common	Percentages
A + B	4	6	12	22	28.7%
A + B + C	4	5	8	17	22.1%
A + B + C + D	3	2	6	11	14.3%
A + C	5	5	14	24	31.2%
B + C	8	9	19	36	46.7%
B + D	6	4	11	21	27.3%
C + D	12	14	21	47	61.0%
A + D	3	2	7	12	15.6%
B + C + D	6	3	11	20	26.0%
A + C + D	3	2	7	12	15.6%
A + B + D	3	2	6	11	14.3%

As would be expected, the affinities between the Pacific Coast and Eastern faunas are least developed, while those between the Sierra-Cascade and Rocky Mts. and especially those between the latter and the Eastern fauna are much greater.

If to the Transition and Boreal forms included in the tables we add the species, subspecies and varieties of the Lower and Upper Sonoran and Lower and Upper Austral Zones, the quantitative and qualitative differences between the western and eastern ant-faunas are even more striking. The same would be true of a comparison of the subgenera and genera of the two regions, for we find that, if we exclude the neotropical elements, no less than eight genera and subgenera are restricted to the western fauna (*Liometopum, Messor, Deromyrma,* *Neomyrma, Symmyrmica* and *Myrmecocystus*) and seven are peculiarly eastern (*Bothriomyrmex, Hypoclinea, Strumigenys, Epoecus, Dichothorax, Harpagoxenus* and *Brachymyrmex*). Moreover certain genera are almost exclusively western or eastern. *Pogonomyrmex* e. g., represented by numerous species in the Southwestern States has only one species (*P. badius*) in the Southeastern States, and *Proceratium* and *Sysphincta* are at any rate very largely confined to the East.

The great majority of the forms recorded in the tables are undoubtedly peculiar to the Transition Zone. Only the following would seem to belong to the Canadian, or boreal fauna:

Myrmica brevinodis vars. *sulcinodoides, canadensis,* and *frigida,*
M. scabrinodis subsp. *lobicornis* var. *glacialis,*
Leptothorax acervorum subsp. *canadensis* and its vars. and the subsp. *crassipilis,*
L. muscorum and its vars.,
L. provancheri,
L. emersoni and its subspecies,
Stenamma nearcticum,
S. brevicorne, its subspecies and varieties,
Lasius niger var. *sitkaënsis,*
L. flavus subsp. *claripennis,*
L. umbratus subsp. *subumbratus,*
Formica bradleyi,
F. sanguinea and subsp. *subnuda* and *aserva,*
F. rufa obscuripes and its var. *melanotica,*
F. truncicola and its subspecies and varieties,
F. whymperi and its varieties,
F. dakotensis and its varieties,
F. ulkei,
F. fusca and its varieties *neorufibarbis, marcida, subaenescens, argentea, gelida* and *algida* and the subsp. *pruinosa,*
F. hewitti,
F. cinerea var. *altipetens* and *canadensis,*
F. neogagates, its subspecies and var. *vetula,*
Camponotus laevigatus,
C. herculeanus var. *whymperi* and subsp. *ligniperda* var. *noveboracensis.*

Most of these are what the Germans would call "stenotherm kälteliebend" (stenothermal psychrophilous). Some of them, however, and especially those common to the four regions of the tables, are strikingly eurythermal ("eurythermal ubiquists" of Zschokke, 1907, 1908). A list of the latter would include the following:

Myrmica scabrinodis and most of its subspecies and varieties,
Aphaenogaster subterranea subsp. *occidentalis*,
Tapinoma sessile,
Prenolepis imparis,
Lasius niger subsp. *alienus* var. *americanus*,
L. brevicornis,
L. flavus subsp. *nearcticus*,
Formica sanguinea subsp. *rubicunda*, *subintegra* and *subnuda*,
F. fusca and its varieties *subsericea* and *argentea*,
F. cinerea var. *neocinerea*,
F. neogagates subsp. *lasioides* var. *vetula*,
Polyergus rufescens subsp. *breviceps*,
Camponotus herculeanus subsp. *pennsylvanicus*,
C. fallax var. *nearcticus*,
C. maculatus subsp. *vicinus* and its varieties.

It will be noticed that the bulk of the forms common to all four regions of the tables is made up of some eight of the forms included in this list. The ants of both the preceding lists, owing to their pronounced eurythermy or psychrophilous stenothermy, constitute the great majority of the forms common at higher elevations in the mountains of North America. Incidentally attention may be called to the high degree of melanism of nearly all the forms enumerated in these lists. This is a well-known peculiarity of many arctic-alpine insects (*Cf.* Zschokke, 1908, p. 42).

The ant-fauna of the Nearctic Transition and Boreal Zones as a whole shows very close affinities to the fauna of the corresponding zones of the Palearctic Region, as will be evident from a study of the following list in which the most closely allied forms of the two regions are arranged in parallel columns:—

Palearctic	*Nearctic*
Ponera coarctata	P. coarctata subsp. pennsylvanica
Monomorium minutum	M. minimum
Solenopsis fugax	S. molesta
Myrmica sulcinodis	M. brevinodis
M. scabrinodis var. sabuleti	M. scabrinodis var. sabuleti
M. scabrinodis subsp. lobicornis	M. scabrinodis subsp. lobicornis var. glacialis

Palearctic	*Nearctic*
M. scabrinodis subsp. schencki	M. scabrinodis subsp. schencki var. emeryana.
M. levinodis	M. levinodis subsp. neolevinodis
M. rubida	M. mutica
Leptothorax acervorum	L. acervorum subsp. canadensis
L. muscorum	L. muscorum var. sordidus
L. flavicornis	L. curvispinosus and rugatulus
Harpagoxenus sublevis	Harpagoxenus americanus
Formicoxenus nitidulus	Symmyrmica chamberlini
Stenamma westwoodi	Stenamma nearcticum
Aphaenogaster subterranea	A. subterranea subsp. occidentalis
Tapinoma erraticum	T. sessile
Bothriomyrmex meridionalis	B. dimmocki
Liometopum microcephalum	L. occidentale
Hypoclinea 4-punctata	H. plagiata
Prenolepis imparis subsp. nitens	P. imparis
Lasius niger	L. niger var. sitkaënsis and neoniger
L. niger subsp. alienus	L. niger subsp. alienus var. americanus
L. flavus	L. flavus subsp. nearcticus
L. umbratus subsp. mixtus	L. umbratus subsp. mixtus var. aphidicola
Formica sanguinea	F. sanguinea subsp. rubicunda
F. rufa subsp. pratensis	F. rufa subsp. obscuripes
F. truncicola	F. truncicola subsp. integroides
F. exsecta	F. exsectoides
F. fusca	F. fusca
F. cinerea	F. cinerea var. neocinerea
F. rufibarbis	F. rufibarbis var. occidua
Polyergus rufescens	P. rufescens subsp. breviceps
Camponotus herculeanus var. whymperi	C. herculeanus var. whymperi
C. herculeanus subsp. ligniperda	C. herculeanus subsp. ligniperda var. noveboracensis
C. herculeanus subsp. pennsylvanicus	C. herculeanus subsp. pennsylvanicus
C. fallax	C. fallax var. nearcticus
C. maculatus subsp. aethiops	C. maculatus subsp. vicinus
C. truncatus	C. impressus

In this list of 41 Nearctic forms 25 are specifically, 6 subspecifically and two varietally identical with Palearctic forms.

The results of the foregoing study of the Transition and Boreal ant-fauna agree in the main with those derived from other animals and of plants, and suggest the same problems as to the original source of the North American ant-fauna, the meaning of the differences between its western and eastern constituents and of the much greater richness of the former in species, subspecies and varieties. An intensive study of the geographical distribution of any circumscribed group of organisms necessarily involves an appeal to general historical considerations, since no group can be satisfactorily studied as an isolated unit. One is compelled, therefore, to assume an attitude towards certain hypotheses which have been gradually elaborated and are more or less firmly supported by the researches of many workers on many different groups. In assuming such an attitude one is inevitably more or less biased by the particular group or groups with which one is most familiar. Before considering the hypothetical centers of origin and the migrations of the various existing categories of insects and especially of the ants, it seems advisable to determine, if possible, the geological age of these categories. This has been attempted in three different ways: first, by a study of paleontology, second, by a study of present distribution on the supposition that forms with a wide and especially with a wide and discontinuous range are older than forms with a limited, continuous range, and third, by a combination of both of these methods. It is evident that the first method is of great importance, the second by itself of comparatively little value and open to many objections, and that the value of the third method depends largely on the paleontological facts to which it may be able to appeal. It is, however, the most comprehensive method and owing to the incompleteness of the paleontological record, the only one that can be resorted to in the study of many groups of organisms at the present time.

Our knowledge of fossil ants is rather limited but of great significance. The earliest known species are those of the Baltic amber, of Lower Oligocene age. Mayr (1868) and I (1914) have described nearly a hundred of these belonging to no less than 43 genera, 19 of which are extinct and 24 still extant, viz: *Ectatomma* (subgen. *Rhytidoponera*), *Euponera* (subgen. *Trachymesopus*), *Platythyrea, Ponera, Sima, Monomorium, Erebomyrma, Vollenhovia, Stenamma, Aphaenogaster, Myrmica, Leptothorax, Dolichoderus* (subgen. *Hypoclinea*), *Iridomyrmex, Liometopum, Plagiolepis, Gesomyrmex, Dimorphomyrmex, Oecophylla, Prenolepis, Lasius, Formica, Pseudolasius* and *Camponotus.*

From the Scilian amber, which is of later, Miocene age, Emery (1891) has described 14 ants representing 13 genera, 11 of which are still extant, viz: *Ectatomma, Ponera, Cataulacus, Podomyrma* (subgen. *Acrostigma*), *Aëromyrma, Crematogaster, Tapinoma, Technomyrmex, Plagiolepis, Gesomyrmex* and *Oecophylla.* Heer (1848, 1849) had previously described a number of ants from the Miocene shales of Oeningen and Radoboj, but owing to the imperfectly developed taxonomic categories of his day, referred them to such generalized genera as *Formica, Ponera* and *Myrmica.* Mayr (1867), however, examined many of Heer's types from Radoboj and was able to recognize among them representatives of the following modern or extant genera: *Aphaenogaster, Leptothorax, Liometopum, Dolichoderus* (subgen. *Hypoclinea*), *Lasius, Formica, Oecophylla* and *Camponotus.* Among several thousand ants from Florissant, Colorado, also of Miocene age, I am now able to recognize specimens belonging to the recent genera *Pheidole, Crematogaster, Aphaenogaster, Liometopum, Dolichoderus* (subgen. *Hypoclinea*), *Lasius, Formica* and *Camponotus,* in addition to a few extinct genera (e. g. *Agroecomyrmex*). It is evident, therefore, that a large number of important ant genera of the present had been developed by early Tertiary times, and as the species representing these genera are quite as highly specialized as their existing congeners, I believe that we must assume that their genera go back at least to the Basic Eocene or even to the Upper Cretaceous. And since these genera clearly represent four of the five subfamilies of living ants, and among them the most highly specialized subfamily, the Camponotinae, we are justified in assuming that the subfamilies of the Formicidae were differentiated during the Mesozoic, probably as early as the Jurassic or Triassic. This assumption is in general accord with the opinions of Emery (1893) and Handlirsch (1913). According to the latter "we know today that by the end of the Cretaceous all the main groups of insects had been completed, that the species living today arose not later than the Pleistocene and the majority of them in the Pleiocene and in certain cases go back even to the Oligocene. The present genera were certainly nearly all completed in the late Tertiary, many of them already in the Oligocene and perhaps some of them in the Upper Cretaceous." He believes (1909) that the Formicidae as a family could scarcely have originated before the Upper Cretaceous. I am inclined to believe that these estimates, at least as far as the ants are concerned, are too conservative. If I understand Emery correctly, his estimates are somewhat closer to my own, for he is inclined to assign the genera of the oldest subfamily, the Ponerinae, and several Myrmicine genera to the Mesozoic, and many Dolichoderinae and Camponotinae to the early Tertiary. Kolbe (1913), however, comes still closer to my point of view in a very suggestive study of the distribution of certain ancient genera of Coleoptera, an order which can scarcely be much older than the Hymenoptera. He calls attention to the fact that if we compare the beetles of Australia and Europe we find that they possess no less than 146 genera in common, and that owing to the fact that Australia was isolated during the Eocene we are justified in regarding all such genera as of Mesozoic age. I believe that the same conclusion is admissible in the case of other insects and especially in regard to the ants and would hold good also of the genera common to Australia and America. In the following list, including all the known genera of Australian ants, the genera printed in large type are represented also in the Neotropical and Nearctic faunas and those preceded by an asterisk occurred in the Tertiary of Europe or are represented in the living fauna of that continent:

SPHINCTOMYRMEX
*CERAPACHYS
Phyracaces
Myrmecia
Amblyopone
*PLATYTHYREA
ACANTHOPONERA
Onychomyrmex
Paranomopone
Diacamma
*ECTATOMMA
Bothroponera
Odontoponera
*EUPONERA
*PONERA
Dorylozelus
Prodiscothyrea
Prionogenys
LEPTOGENYS
*ANOCHETUS
ODONTOMACHUS
Aenictus
Metapone
*Sima
*Oligomyrmex
Pheidologeton
*CREMATOGASTER
*SOLENOPSIS
*PHEIDOLE
Lordomyrma
*Vollenhovia
*Podomyrma
*MYRMECINA
Machomyrma
Dacryon
*MONOMORIUM
*CARDIOCONDYLA
*APHAENOGASTER
*TETRAMORIUM
Pristomyrmex
Triglyphothrix
Mayriella
ROGERIA
Prodicroaspis
Promeranoplus
Meranoplus

Calyptomyrmex
*STRUMIGENYS
*EPITRITUS
Orectognathus
Epopostruma
Rhopalothrix
*DOLICHODERUS (subgen. HYPOCLINEA)
Leptomyrmex
Frogattella
Turneria
*IRIDOMYRMEX
*BOTHRIOMYRMEX
*TAPINOMA
*Technomyrmex
Acropyga
*Plagiolepis
*Acantholepis (subgen. Stigmacros)
Prolasius
Melophorus
*Pseudolasius
Notoncus
*Oecophylla
Myrmecorhynchus
*PRENOLEPIS
Opisthopsis
Echinopla
Calomyrmex
*CAMPONOTUS
Polyrhachis

Of the 75 genera in this list 31 or 41.3% are known to exist or have existed in Europe and 27 or 36% in America; 37 or 49.3% are unknown in either of these regions, but more than half of them are represented in the Oriental region. As the migration of ants from the latter region into Australia since its isolation has been very much restricted, these genera must also be regarded as of Mesozoic origin. It should also be noted that 21 or 28% of the 75 Australian genera belong to the most ancient and primitive subfamily of the Ponerinae, a group comparable to the Monotremes and Marsupials among mammals and one which reaches no such proportions in any of the other geographical regions. I believe, therefore, that we have underestimated the antiquity of the genera of ants and that the great majority of them are of Pretertiary or at the latest of early Eocene development. The same may be true even of certain species of tropicopolitan or cosmopolitan distribution, e. g. *Solenopsis geminata*, *Odontomachus haematoda* and especially *Camponotus* (*Myrmoturba*) *maculatus*, which is represented by numerous local races and varieties not only on all the continents but also on many islands (*e. g.* Hawaii!). There are good reasons for believing, however, that the great majority of existing species and subspecies are of Postmiocene origin. In North America and Eurasia, at any rate, only subspecies and varieties seem to have developed since the Ice Age. This is indicated by the very small number of varieties common to the Nearctic and Palearctic faunas as compared with the number of common species and subspecies (see pp. 485–486).

Paleographers agree in characterizing the Upper Jurassic as a period of great continental emergence, warm climate and a cosmopolitan flora. During this and the ensuing Cretaceous most of the families and genera of insects, like the flora on which so many of them were vitally dependent, must have assumed their modern facies and have become very widely distributed. According to Osborn (1910, p. 95) the "most memorable fact about the flora is one recently insisted upon by Knowlton (1909), namely that as we pass from the Cretaceous into the Eocene there is no appreciable change in the flora. From this it would appear that there was no secular change of climate; that the temperature was the same." There is nothing to indicate that the insects underwent any profounder change than the plants, so that we are unable to believe that these animals exhibited anything like the catastrophic elimination which occurred in several other groups of organisms both terrestrial and aquatic at the end of the Cretaceous. There is therefore no justification for assuming a close parallel in the course of development of such insects as the ants during the Tertiary with that of the mammals, whose phylogeny during that period was very complicated and greatly accelerated. The repeated migrations of mammals between North America and Eurasia during Cretaceous and Posteocene time were probably paralleled by the ants but we have no precise evidence of such movements. A single land-bridge, the Siberian-Alaskan, which is accepted by all students of geographical distribution, and according to most of them was in existence during the Cretaceous and again from late Miocene to Pleistocene times, is sufficient to account for the present constitution of our North American ant-fauna. Scharff (1907, 1912) and others have adduced considerable evidence in favor of another land-bridge connecting North America with Great Britain and Scandinavia during Preglacial and early Glacial time, but others reject this construction though they have not succeeded in accounting for the fauna and flora of Greenland and Iceland and the distribution of many eastern Nearctic and western European forms on any other hypothesis. That there was a gradual cooling of the climate from late Eocene to the Glacial Epoch is also generally admitted and the resulting development of pronounced zonal climates had a very powerful effect, as we know, on the fauna and flora of the northern hemisphere. The elimination of species thus induced over the area covered by the great ice-sheet both in Europe and North America and the southward migration of surviving species away from its border have been so often discussed that I need not dwell on them here. The ants of the

Baltic amber and of Florissant, like the plants of the same formations, show very clearly the gradual cooling of climate during the early and middle Tertiary. In the latitude of Sweden, where the amber was formed, the climate seems to have been subtropical as early as the Lower Oligocene, since the ants belonging to boreal genera such as *Formica, Lasius, Prenolepis s. str.* etc. constitute a dominant component of the fauna, at least in individuals. During the Miocene the climate of Colorado, as indicated by the Florissant plants, resembled that of the Gulf States at the present time. The ants perhaps indicate a slightly cooler and dryer climate, not unlike that now prevailing at low altitudes in Colorado or New Mexico.

I am inclined to believe, with Scharff, that the extent of the southward migration or displacement of organisms beyond the border of the ice sheet during glacial times has been exaggerated by many authors. Still there must have been some displacement and considerable extinction. It is at any rate clear that owing to the absence of such a complete barrier to southward migration as the Alps and the Mediterranean, our North American fauna suffered much less severely during the Ice Age than that of Europe. Moreover our fauna has been greatly enriched since the Pleistocene by a northward immigration of numerous neotropical species into the Southern United States by way of Mexico and the West Indies. The neotropical immigrants among ants belong to the Doryline genus *Eciton,* to several Ponerine genera (*Neoponera, Pseudoponera, Ectatomma, Leptogenys* and *Odontomachus*), to several Myrmicine genera (*Pseudomyrma, Cryptocerus, Macromischa, Xenomyrmex, Xiphomyrmex,* possibly *Pogonomyrmex* and especially to the fungus-growing tribe Attini (*Atta, Acromyrmex, Trachymyrmex* and *Cyphomyrmex*), to the Dolichoderine genera *Forelius, Dorymyrmex* and *Iridomyrmex* and to the Camponotine genera *Brachymyrmex, Prenolepis* (subgen. *Nylanderia*) and *Camponotus* (subgen. *Myrmothrix, Myrmobrachys* and *Myrmamblys*). Some of these genera (*Pseudoponera, Odontomachus, Leptogenys, Iridomyrmex*) are common to paleotropical regions and at once suggest the question as to whether they originally reached South America during the Cretaceous by way of Antarctica from Australia or came from Asia by way of North America or over other land-connections from other parts of the Old World, and therefore involve a discussion of the hypothetical southern land-bridges, which several recent writers, notably H. von Ihering and Scharff, have been very actively constructing in order to explain certain cases of wide and discontinuous distribution among organisms. So far as the Formicidae are concerned I unreservedly agree with those who repudiate all such connections, with the exception of the Siberian-Alaskan and possibly the North Atlantic bridges. I am quite unable to find anything in the neotropical ant-fauna that makes it necessary to assume former connections of South America with Australia or with Africa. The only genus supposed to be peculiar to Australia and South America is *Melophorus*, which is represented by numerous species in the former region and to which Forel and Emery referred a few Chilian and Patagonian species formerly regarded as belonging to the holarctic genus *Lasius*. But Emery later showed that the Chilian and Patagonian forms really constitute a distinct subgenus, which he called *Lasiophanes*. From a recent study of the Australian species I am convinced that they should be generically separated from the South American species. So far as Africa and South America are concerned, they have no genera in common which have not a much wider distribution in the Palearctic or Oriental regions.

Among the numerous writers on geographical distribution who have recently rejected or ignored the speculations of the bridge-builders, I will consider only Kolbe, Handlirsch and Matthew, as they seem to me to have reached conclusions very similar to those suggested by my study of the Formicidae. These writers recall those who, like Allen (1878), Scribner (1882) and Haacke (1887) long ago pointed to the north polar region as the original center of organic distribution, but differ in placing this center in Central or Eastern Asia. Kolbe (1913) calls attention to the vast extent and great permanence of the Asiatic continent during geologic time as contrasted with Europe and selects the region between the Caspian Sea and Eastern China, and especially Turkestan and Thibet, as the most ancient of the sources and reservoirs of Palearctic animal life. This is indicated by both the mammals and the insects. Of the single beetle genus *Carabus* Central Asia alone possesses 35 endemic subgenera! Europe is merely a zoögeographical appendix of Asia, to which the African, Australian and North American faunas are easily traceable by emigration during the Cretaceous when there existed a broad Siberian-Alaskan land-bridge.

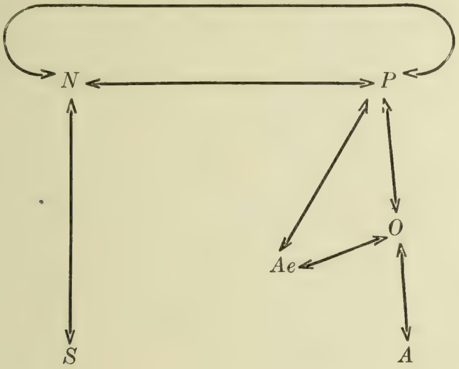
Kolbe does not discuss the origin of the neotropical fauna nor the antarctic and other land-bridges, but Handlirsch (1913) comes to close grips with these constructions in a valuable statistical study of more than 16,000 insect genera, comprising 180,000 species or about one third of the known forms. His results in regard to the distribution of the endemic as contrasted with the more widely distributed genera in the various geographical regions are given in the following interesting table:

	Total of Genera	a. Endemic Genera	b. More widely distributed Genera	Ratio a to b
Neotropical	5617	3437	2180	1:0.63
Nearctic	3467	797	2670	1:3.35
Palearctic	4956	1859	3097	1:1.67
Ethiopian	3968	2249	1719	1:0.76
Oriental	4137	1641	2496	1:1.52
Australian	3101	1400	1701	1:1.21

Of Wallace's regions, the Neotropical, owing to its very large proportion of endemic genera, is therefore the most independent and best established, the Nearctic the least. In an examination of 8300 selected genera, Handlirsch finds that only about 4% have a discontinuous distribution and would therefore constitute the chief basis for the contentions of the bridge-builders. But it appears that the generic relations between the Neotropical and Ethiopian regions, for which von Ihering constructed his "Archhelenis" land-bridge, are actually feebler than those between the Neotropical and Oriental, or between the Nearctic and Oriental or between the Palearctic and Australian! Furthermore, the Neotropical is really more closely related to the Palearctic than to the African insect fauna. These facts are clearly brought out in the following numbers of genera found to be common to the different regions, after excluding the cosmopolitan species:

Palearctic and Nearctic	1225
Nearctic and Neotropical	1159
Palearctic and Oriental	1083
Oriental and Australian	754
Oriental and Ethiopian	701
Palearctic and Ethiopian	687
Palearctic and Neotropical	571
Palearctic and Australian	472
Nearctic and Oriental	306
Neotropical and Oriental	259
Ethiopian and Australian	327
Neotropical and Australian	228
Neotropical and Ethiopian	195
Nearctic and Australian	197
Nearctic and Ethiopian	159

The study of such a circumscribed group as the Formicidae would be even more unfavorable to the views of von Ihering and other bridge-builders than the more comprehensive studies of Handlirsch, because the relationships of the ants of South America to those of Africa or Australia would be represented, as I have stated, only by genera of cosmopolitan range or at any rate common to the Palearctic and Oriental regions, from which they could have found their way to the New World over the Behring Sea and North Atlantic land-bridges. Handlirsch summarizes his views on the migrations of forms between the different regions in the following simple diagram, in which *S* stands for the Neotropical and *Ae* for the Ethiopian region:



Matthew (1915) has reached very similar conclusions from a study of the distribution of Vertebrates and particularly of the mammals. He finds the same fallacies as Handlirsch in the work of the bridge-builders and expresses them in the following paragraphs:

"1. The discontinuous distribution of modern species is again and again taken as proof that the regions now inhabited must have been connected across deep oceanic basins, without considering the possibility that it is a remnant of a wider past distribution, or that it is due to parallel evolution from a more primitive type of intermediate distribution, now extinct. Yet so many instances are known where the geological record has furnished proof that one or the other of these explanations applies to cases of discontinuous distribution, that it would seem that these ought to be the first solutions of the problem to be considered, and that in view of the known imperfection of the geologic record, mere negative evidence is not sufficient to cause them to be set aside.

"2. No account is taken of faunal interchanges often much more extensive, which would presumably have taken place if the land-bridges assumed had existed, but which have not taken place. It may here be urged that this too is negative evidence. But the negative evidence derived from an appeal to the geological record is weak, not *per se*, but because of the demonstrated imperfection of the record. On the other hand, there are many instances where a land-bridge is well proven, and in these cases it is not a few scattered exceptions, but an entire fauna that has migrated, subject only to the restrictions imposed by climatic or topographic barriers of other kinds."

In accounting for the present discontinuous distribution of many ancient and primitive forms Matthew seems to me to have made good use of a principle which seems to have been first suggested by Haacke (1887). This writer called attention to the fact that at the present time the most primitive types of the various groups of animals are mostly confined to the tropics and the southern hemisphere. This can be most readily explained on the supposition that the situations in which such forms now live are not their original habitats but those to which they have been relegated by more recent and more specialized forms evolving and usurping their places in the territory originally occupied by the group. Hence the oldest and most primitive members of a group come to be found today at the periphery of its range and the more recent and specialized forms in or near its center. Clark (1915) has reached the same conclusion from his study of the distribution of the Onychophora. He says: "Any animal type, once evolved, will extend itself immediately in every direction as far as the natural barriers to its dispersal; a more specialized form (a dominant type) of the same animal, better fitted for the conditions under which it lives, will sooner or later be evolved somewhere in the central, or more favorable portion of the territory inhabited by the original type; this new type will at once extend itself as did the original type; but in the meantime there may have arisen certain barriers, which the second type cannot cross and beyond which, therefore, the first type is secure. Up to these barriers — high mountains, deserts, newly formed arms of the sea, or whatever they may be — the second type will gradually supplant the first, as a result of its better economic equipment and more perfect physical resistence, and the advantage which this better equipment and resistance give it in the struggle for existence. Thus we shall eventually find a specialized type beyond the limits of which occurs a more generalized type of the same organism. The subsequent evolution of additional types, which will most frequently occur at or near the so-called center of distribution as a natural result of the greater facility for adaptation due to the greater distance apart of the physico-economic barriers and the consequently greater radius of each type, will result in the gradual formation of a dispersal figure which would be ideally represented by a series of concentric circles, each of the circles representing a barrier, the small central circle enclosing the most perfected type and the peripheral band the most generalized, the intervening areas including intermediate types increasing in specialization toward the center."

The Formicidae show in a very striking manner the relegation of the most primitive forms to the tropics and southern hemisphere and especially to the Neotropical, Oriental and Australian regions. As all of these forms are exquisitely thermophilous and stenothermal, whereas the Palearctic and Nearctic faunas and particularly the forms peculiar to the mountains consist of more specialized, stenothermal and psychrophilous species together with a small number of eurythermal ubiquists, we are led to believe that the development of zonal climates during the Tertiary has been the essential factor in determining the distribution of the present world-wide distribution of ants. The mountain faunas are therefore of comparatively recent origin and this is particularly true of that of the Rocky Mountains, to judge from the large number of subspecies and varieties, most of which have, in all probability, developed since the Pleistocene. The Rocky Mountains as an independent center of formation of new forms contrast markedly with the Alps and Himalayas, for there are relatively few ants peculiar to the latter and especially to the Alps. This may be attributed to geological conditions. Geologists maintain that the Rocky Mountains began to be elevated as early as late Cretaceous time and by the Eocene had attained altitudes of 4000 to 5000 feet. They continued to rise during the Tertiary Period to altitudes of 13,000 to 14,000 feet, with a corresponding elevation of the bases between them and considerable erosion of their summits. The Alps however, did not appear till the close of the Oligocene and only during the Miocene were the Himalayas uplifted. The Alpine area, moreover, was surrounded by water till the Miocene when it became joined by a broad land-connection with Central Asia. Its connection with France by means of another land-connection is said to have occurred at the end of the Miocene. These conditions, together with the later extensive glaciation of the Alps, must have been very potent factors in preventing the development of an indigenous ant fauna. On the other hand the Rocky Mountains occupy a very large area and were much less affected by the unfavorable climate of the Ice Age. They therefore remained as a preserve of Pleiocene species and during more recent times became a center of origin of many races and varieties. For evidence in support of this contention we have only to compare the Nearctic and Palearctic forms of the genera *Myrmica, Leptothorax, Lasius, Formica, Polyergus* and *Camponotus.*

I advanced the opinion that the Rocky Mountains were probably the center of origin of the genus *Formica* in my paper on this group (1913), but I now accept Handlirsch's view that not only the genus *Formica,* but the whole family Formicidæ had its origin during the Mesozoic in Eurasia and believe, with Kolbe, that Central or Eastern Asia is, as seems to be the case with so many other groups of organisms, the most likely spot in which to seek the origin of the ants. The views of Matthew and Clark on the development of the specialized forms in the center of the geographical range of a group and the relegation of the older and more primitive forms to the periphery of that range, appear at first sight to support my former contention, but it now seems to me to be more probable that the Rocky Mountains constitute only a secondary, more recent center of speciation, and that they are much more important as a region of conservation. It may be noted in this connection that Japan is evidently a similar secondary center of speciation for the same genera, since in that country the common holarctic species of *Myrmica, Lasius, Formica, Polyergus* and *Camponotus* have developed several peculiar subspecies and varieties. The same is true of the Eastern United States, which are also characterized by the development of endemic forms of *Myrmica, Formica,* etc.

This brings us, finally, to the problem with which we started, the pronounced difference between the ant faunas of western and eastern North America, a difference very similar to what has been so often noticed in other groups of organisms. It may be readily attributed to a difference in survival after the glaciation of the northern portion of the continent, since the ice-sheet is known to have advanced considerably further south in the eastern than in the western half of the continent, while the Gulf of Mexico formed an impassable barrier to a directly southward emigration of species. Hence we should expect a much more meager survival of species in the Eastern than in the Western United States. The differences of character in the endemic forms of the two regions, however, must be due to other conditions, some of which were undoubtedly preglacial, while others were as clearly postglacial. If we may judge from the Florissant deposits, the North American ant-life of Miocene times was poorer in species than that of Europe, but we must bear in mind that the Florissant locality is a very limited and elevated area and that the preserved ants are nearly all males and females which happened to fall into a small lake during their nuptial flight and after sinking to the bottom became embedded in volcanic sediment. Many of the species became extinct, but some of them, notably those of the genera *Aphaenogaster, Lasius* and *Liometopum,* were undoubtedly very closely related to forms of the same genera still living in Colorado. To the descendants of this Miocene fauna there was added during the Pleiocene a number of forms by immigration from Asia over the Siberian-Alaskan land-bridge, probably at the same time and by the same route as the Strepsicerine and Hippotragine antelopes. Probably, too, certain North American ants passed into Asia at the same time, just as seems to have been the case with the camels. Emery has recorded the occurrence of *Camponotus herculeanus* subsp. *pennsylvanicus* in Siberia and Burmah, and the closely related *C. japonicus* was originally described by Mayr as a mere variety of that subspecies. Probably such species as *Aphaenogaster subterranea, Myrmica lobicornis, Leptothorax muscorum,* some form of the subgenus *Neomyrma* closely related to the Eurasian *rubida* and the ancestor of *N. mutica, hunteri* and *aldrichi,* together with several species of *Formica,* notably *cinerea, rufibarbis, rufa, truncicola* and *Polyergus rufescens,* first entered North America during the Pleiocene. Even at the present time few of these species have succeeded in extending their range to the Atlantic States. The origin of the peculiarly eastern forms is more obscure. Probably a number of them are Mesozoic and early Tertiary survivors, notably the Ponerinae, and the species of *Strumigenys, Myrmecina* and *Aphaenogaster.* Others may have come from Europe over the North Atlantic land-bridge during the late Tertiary and have given rise to such forms as *Formica ulkei, exsectoides,* and *pallidefulva* and *Camponotus castaneus.* Some of these have migrated westward as far as the easternmost ranges of the Rocky Mountains but none has reached the Pacific Coast Eurythermal ubiquists like *Tapinoma sessile, Prenolepis imparis* and *Formica fusca* may have existed in North America since the Oligocene or Eocene. *F. fusca* and *P. imparis* are, as I have shown (1914), almost identical with *F. flori* and *P. henschei* of the Baltic amber. That elements derived from such various sources and migrations, probably separated by long periods of time, should have gradually evolved a number of subspecies and varieties in the localities to which they were at first confined, is only what might be expected. And that such varieties and subspecies should be much more numerous in the Rocky Mountains than in the Eastern States is also to be expected, when we consider the much greater variety of physical conditions in that region. The high mountains running north and south through many degrees of latitude, with very high timber and snow lines and often broken into isolated ranges separated by arid basins or "parks," sometimes of great extent, constitute a much more favorable territory for the production of endemic races and varieties than the compact east and west massif of the Alps with their low timber and snow lines and narrow valleys. Some very short mountain ranges, especially in Arizona, New Mexico and Western Texas are, in fact, quite insular, being completely surrounded by the desert from which they rise, and like islands have developed numerous endemic, or precinctive forms. This is very clearly seen in the Huachuca Mountains of Arizona, which are inhabited by several ants and other insects not known to occur in any other localities. The Coast Range and Sierra Cascade Ranges have also each developed a number of endemic forms. Unfortunately we are unable at the present time to appreciate the precise character and extent of this endemicity in our western mountains, because our knowledge of the distribution of any single insect group in any one of the various ranges is very fragmentary. This is equally true of the Appalachian System (White Mountains, Adirondacks, mountains of North Carolina and Georgia). Certainly no more interesting work could be undertaken by our taxonomic entomologists than a detailed and systematic survey of the various groups of insects in all these ranges after the manner of the fine surveys of the distribution of vertebrates and woody plants by Dr. C. H. Merriam and his collaborators.

List and Descriptions of Western Mountain Ants.

MYRMICINAE.

1. *Monomorium minimum* Buckley.

The typical form of this species, which is common in Texas and the Atlantic States at lower elevations and south of New England, has been taken by Prof. C. F. Baker in Ormsby County, Nevada, on the eastern shore of Lake Tahoe. I have found it in Arizona and Colorado and Dr. W. M. Mann collected it in the mountains of Hidalgo, Mexico.

2. *Monomorium minimum* subsp. *ergatogyna* Wheeler.

Known only from Catalina Island, Cala., where it was taken several years ago by Prof. C. F. Baker.

3. *Monomorium minimum* subsp. *compressum* Wheeler.

Taken by Dr. W. M. Mann at Guerrero Mill, Hidalgo, Mexico.

4. *Monomorium minimum* subsp. *cyaneum* Wheeler.

A beautiful metallic blue form from the same locality as the preceding.

5. *Solenopsis molesta* Say.

The typical form of this species is abundant throughout the Eastern United States and Southern Ontario. It occurs also, but more sporadically, in the mountains of Colorado and New Mexico at altitudes below 8000 ft.

6. *Solenopsis molesta* var. *validiuscula* Emery.

Originally described from Los Angeles and San Jacinto, California. I have taken it in the Santa Inez Mts. near Santa Barbara in the same state, and Dr. Mann has give me specimens which he collected at Wawawai, Washington.

7. *Solenopsis molesta* var. *castanea* Wheeler.

A dark color variety originally described from Woodland Park, in the Ute Pass, Colorado (Wheeler).

8. *Myrmecina graminicola* Latr. subsp. *americana* Emery.

A rather rare ant, occurring in rich, shady woods in the Eastern States and as far west as Texas and the Grand Canyon, Arizona.

9. *Myrmecina graminicola* subsp. *americana* var. *brevispinosa* Emery.

In distribution this form is similar to the preceding. I have taken it as far west as New Braunfels, Texas, and have seen specimens collected by Mr. E. S. Tucker at Plano in the same state.

10. *Myrmecina graminicola* subsp. *texana* Wheeler.

Known only from Austin, Texas, where I found it many years ago in moist places in the canyons of the Edwards Plateau.

11. *Myrmica brevinodis* Emery.

The typical form of this species is common in the Transition Zone of Colorado, about Colorado Springs, Denver, Boulder, Buena Vista, etc.

12. *Myrmica brevinodis* var. *brevispinosa* Wheeler.

Known from New Mexico and Colorado.

13. *Myrmica brevinodis* var. *frigida* Forel.

The types of this variety were taken by Whymper in the Ice River Valley, British Columbia (5000 ft.).

14. *Myrmica brevinodis* var. *sulcinodoides* Emery.

British Columbia: Hector, Carbonate and Spillimachen R., Selkirk Mts. (C. J. Bradley); Field and Yoho Pass, Emerald Lake (Wheeler).

Alberta: Lake Louise (Wheeler).

Colorado: Rico, 10,000 ft. and Hayden Peak, 10,000 ft. (E. J. Osler); Boulder and Ward (W. W. Robbins); Lost Lake, Eldora, 9500 ft. (D. M. Andrews).

California: Lake Tahoe, 6000 ft. (Wheeler).

This variety is so much like the typical European *M. sulcinodis* Nyl. that one is inclined to regard *brevicornis* as merely a subspecies. The form described by Forel as *brevinodis* var. *whymperi* from Vermilion Pass, Alberta, is, so far as I am able to judge from two cotypes received from Prof. Forel, merely *sulcinodoides*. For a description and further citations of localities of this variety from Utah, Colorado and New Mexico, see my revision of the forms of *brevinodis* in Bull. Wis. Nat. Hist. Soc. 5, 1907, p. 73 *et seq*. The workers from Lake Tahoe have the epinotal spines rather short and perceptibly curved downward at the tips. It does not seem desirable to regard them as representing a distinct variety.

15. *Myrmica brevinodis* var. *decedens* Wheeler.

Colorado: Buena Vista, 7900 ft. (type locality) and Florissant, 8500 ft. (Wheeler).

New Mexico: Pecos Mts., San Miguel County (Mitchell).

The workers from New Mexico are considerably darker than the types and may prove to belong to a distinct variety.

16. *Myrmica brevinodis* var. *alaskensis* var. nov.

Worker. Length 3.5 mm.

Resembling the variety *sulcinodoides* but smaller and of a different color. Head black above; thorax, pedicel and gaster castaneous; mandibles, antennae and legs brownish yellow. Antennae slightly thicker at the base than in *sulcinodoides.* Rugae on the clypeus very coarse, much fewer in number (only 8) than in other forms of the species; frontal area distinctly outlined, subopaque and very finely punctate, not longitudinally rugulose. Rugae on the sides of the head coarsely reticulate, not longitudinal, those on the thorax and pedicel much as in *sulcinodoides* but a little finer; surface of head, thorax and pedicel a little more opaque. Epinotal spines somewhat shorter than the base of the epinotum, curved downward at their tips. Summit of petiolar node distinctly more rounded than in *sulcinodoides* and transversely rugose, postpetiolar node less convex behind. Pilosity like that of *sulcinodoides.*

Described from eight workers taken at Seward, Alaska by Mr. F. H. Whitney.

17. *Myrmica brevinodis* var. *subalpina* Wheeler.

British Columbia: Hector, Field and Carbonate (J. C. Bradley); Emerald Lake (Wheeler).

Alberta: Banff (Wheeler); Jasper (C. G. Hewitt).

Washington: Orcus Island (W. M. Mann).

This variety, originally described from Florissant, Colo., forms flourishing colonies under logs and stones in moist, sunny places. I found it very abundant on the southern slope of Tunnel Mt. at Banff. It closely resembles the eastern var. *canadensis* Wheeler, but the wings of the male and female are whitish hyaline throughout and not infuscated at the base. The workers of certain colonies present transitions in color to the var. *sulcinodoides,* but this forms smaller colonies and prefers higher elevations.

18. *Myrmica mexicana* Wheeler.

This species, related to our eastern *M. punctiventris* Roger, was taken by Dr. Mann at Guerrero Mill, Hidalgo, Mexico.

19. *Myrmica scabrinodis* Nyl. subsp. *lobicornis* Nyl. var. *glacialis* Forel.

Alberta: Vermilion Pass, type locality (Whymper); Lake Louise and Moraine Lake, Valley of the Ten Peaks (Wheeler).

British Columbia: Emerald Lake (Wheeler); Carbonate and Prairie Hills, Selkirk Mts. (J. C. Bradley).

Montana: Helena (W. M. Mann).

Utah: Salt Lake County (R. V. Chamberlin).

Colorado: Florissant, Ute Pass, Cheyenne Canyon and Manitou (Wheeler); Creede Co. 8844 ft. (S. J. Hunter); Boulder (P. J. Schmitt); Pikes Peak, 10,000 ft., Willow Creek and West Cliff, 7864 ft. (T. D. A. Cockerell).

New Mexico: Harvey's Ranch, Las Vegas Range, 10,000 ft. (E. L. Hewett); Beulah, 8000 ft. (T. D. A. Cockerell).

Arizona: San Francisco Mts., 13,000 ft. (W. M. Mann); Coconino Forest, Grand Canyon (Wheeler).

Forel described this form from worker specimens as a variety of the typical *scabrinodis*, but has more recently placed it under the subsp. *schencki* Emery. During the summer of 1915 I found the males and females in many nests in British Columbia and Alberta and these phases show unmistakably that *glacialis* must be regarded as a form of *lobicornis*, a subspecies common in the Alps and Northern Europe but not hitherto known to occur in America. The antennal scapes of the male *glacialis* are strongly bent at the base and fully $\frac{2}{5}$ as long as the funiculus. They are therefore only a little shorter than in typical *lobicornis*. The other differences are equally insignificant. The *glacialis* male is a little smaller and has somewhat shorter epinotal teeth, the sculpture of the head and thorax is somewhat feebler so that the surface is more shining. The female is also somewhat smaller than the female of the typical form, its head and thorax are more shining and less coarsely sculptured, and the thorax and pedicel are darker, the angles at the base of the antennal scapes decidedly smaller. The worker specimens from the Grand Canyon, San Francisco Mts. and Boulder have the antennal lobes large and more flattened, much as in the typical *lobicornis*. The specimens from Helena are considerably paler and colored like the eastern *sabuleti*, but the greater length of the antennal scape in the male shows that they should be placed with *lobicornis*, although they may represent a distinct variety.

20. *Myrmica scabrinodis* subsp. *schencki* Emery var. *tahoënsis* var. nov.

Worker. Length 3.3–4 mm.

Small; antennal scapes geniculately bent at the base and at the flexure with a small rounded lobe, appearing as an acute tooth when the scape is seen from the side. Frontal area very distinct, triangular. Frontal carinae large, lobular. Epinotal spines slightly shorter than the base of the epinotum, as long as their distance apart at the base, rather slender, distinctly curved downwards at their tips. Petiole in profile blunt and rounded above.

Head, thorax and pedicel very coarsely and in the main longitudinally rugose, the surface subopaque; frontal area opaque, finely and densely longitudinally rugulose; concavity of epinotum smooth and shining like the gaster.

Hairs rather long, abundant and suberect on the body and legs as in the typical *schencki* var. *emeryana* Forel.

Head and gaster black; mandibles, antennae, thorax, petiole and post-petiole deep brownish red; legs slightly more yellowish red.

Female (deälated). Length 4.5–5 mm.

Very similar to the worker; pronotum transversely, mesonotum and scutellum strongly, pleurae more feebly longitudinally rugose; petiole and postpetiole longitudinally rugose above, densely and finely punctate on the sides and below as in the worker. Color like that of the worker, except that the thoracic dorsum and some spots on the pleurae are black.

Male. Length 3.5–4 mm.

Antennae very short, the scapes especially, which are feebly bent at the base and not more than three times as long as broad and shorter than the three basal funicular joints together; club 4-jointed. Frontal area large, distinct, triangular. Sculpture and pilosity much as in the var. *emeryana.* Color dark piceous brown; head black; mandibles, tarsi and articulations of legs brownish yellow; palpi whitish. Wings pale hyaline throughout, not infuscated at the base as in *emeryana.*

Described from numerous workers, several males and two females from several localities about Lake Tahoe (Tallac, Angora Lake, Glen Alpine Springs, Fallen Leaf Lake). The colonies are small and nest under stones in shady places.

21. *Myrmica scabrinodis* subsp. *schencki* var. *monticola* var. nov.

Worker. Length 3–3.5 mm.

Differing from the vars. *emeryana* and *tahoënsis* in its smaller size, in color and in the shape of the antennal scapes, which are rectangularly bent at the base and furnished at the flexure with a large, rounded, shovel-shaped, transverse lobe, which is prolonged as a low membranous ridge for a short distance along the posterior edge of the joint. Frontal carinae suberect; frontal area small but distinct, triangular. Epinotal spines shorter than the base of the epinotum and than their distance apart at the base, straight, slender and acute. Sculpture of the mandibles, head, thorax and pedicel sharp but rather loose and the punctuation of the interrugal spaces very shallow, so that the surface is much more shining than in the other varieties of *schencki.* Rugae of the pro- and mesonotum very coarse, vermiculate, indistinctly longitudinal. Middorsal portion of postpetiole rather smooth and shining, somewhat as in the var. *detritinodis* Emery.

Pilosity rather long, abundant, coarse, erect and blunt on the body, appressed on the legs.

Color brownish yellow; scapes and legs of a clearer, paler yellow; head more brownish above; first gastric segment dark brown.

Male. Length 3.8–4.9 mm.

Antennae much as in the var. *tahoënsis*, the scape being distinctly shorter than the three basal funicular joints together. Surface of body shining, feebly sculptured; head finely and densely punctate, with indistinct rugae; the rugae on the thoracic dorsum also very faint. Protuberances of epinotum very blunt.

Color brown; head darker; mandibles, thoracic sutures, margins of gastric segments, antennal clubs, legs and tarsi, except the middle portions of the femora and tibiae, brownish yellow.

Described from a dozen workers and nine males taken by myself at Buena Vista, Colorado.

This is a very distinct form, which in the larger lobe of the antennal scapes approaches the typical European *schencki* more closely than do either of the varieties *tahoënsis* or *emeryana.* There are, however, in the Eastern States one or more large, dark, undescribed varieties which have a similar extensive antennal lobe.

22. *Myrmica* (*Neomyrma*) *bradleyi* Wheeler.

California: Glacier Point, Yosemite, 8000 ft. and Tallac, Lake Tahoe 6000 ft. (Wheeler).

This form was recently redescribed by Forel as *Aphaenogaster* (*Neomyrma*) *calderoni* from specimens taken by Calderon in the Lake Tahoe region. The types were taken by Prof. J. C. Bradley in Alta Meadow, Tulare Co., Cala., at an altitude of 9500 ft. It nests under stones in rather dry, sunny places and in habits closely resembles *M.* (*N.*) *mutica* Emery. The localities for this and two other species are here transcribed from my recent paper on the American species allied to *M. rubra* Latr. (Psyche, 21, 1914, pp. 118–122).

23. *Myrmica* (*Neomyrma*) *mutica* Emery.

Colorado: Denver; type locality (E. Bethel); Colorado Springs, Salida, Buena Vista and Wild Horse, 6000–7000 ft. (Wheeler); Canyon City (Rev. P. J. Schmitt).

New Mexico: (Ern. André).

Utah: Salt Lake County (R. V. Chamberlin), as the host of the peculiar xenobiotic ant, *Symmyrmica chamberlini* Wheeler.

Washington: Olympia (T. Kincaid); Ellensburg and Pullman (W. M. Mann).

Alberta: McLeod (C. G. Hewitt).

British Columbia: Dog Lake, Penticton (C. G. Hewitt).

24. *Myrmica* (*Neomyrma*) *aldrichi* Wheeler.

Idaho: Moscow (J. M. Aldrich).

25. *Myrmica* (*Neomyrma*) *hunteri* Wheeler.

Montana: Madison R. near Beaver Creek, 7500 ft. (S. J. Hunter).

26. *Leptothorax andrei* Emery.

Originally described from California. I possess several workers taken by Dr. W. M. Mann at Palo Alto in that state.

27. *Leptothorax eldoradensis* Wheeler.

Taken on Mt. Wilson near Pasadena by Prof. J. C. Bradley.

28. *Leptothorax schmitti* Wheeler.

Known only from Canyon City, Colo.

29. *Leptothorax neomexicanus* Wheeler.

Described from Manzanares, New Mexico.

30. *Leptothorax nitens* Emery.

Known from Utah, California and Colorado.

31. *Leptothorax nitens* var. *heathi* Wheeler.

Known only from California.

32. *Leptothorax nitens* var. *mariposa* var. nov.

Worker. Resembling the var. *heathi* in being brown, with yellow legs and antennae, but the thorax is opaque and densely punctate throughout, like the petiole and postpetiole. The punctures are decidedly coarser than in this variety and the typical form. The tips of the antennal scapes nearly reach the posterior corners of the head, being separated from them only by a distance equal to the greatest transverse diameter of the scape.

Several workers found nesting under the edges of stones in dry places in Tenaya Canyon, Yosemite Valley, Cala.

33. *Leptothorax nitens* subsp. *occidentalis* Wheeler.

Described from Friday Harbor, Washington.

34. *Leptothorax melanderi* Wheeler.

Taken on Moscow Mt., Idaho by Prof. A. L. Melander.

35. *Leptothorax furunculus* Wheeler.

Taken in Williams Canyon, near Manitou, Colo. at an altitude of 7500 ft.

36. *Leptothorax tricarinatus* Emery.

Described from a single worker specimen taken by Pergande at Hill City, South Dakota. I have not been able to recognize it among my specimens of *Leptothorax*.

37. *Leptothorax nevadensis* Wheeler.

Described from King's Canyon, Ormsby County, Nevada, where it was taken by Prof. C. F. Baker. This locality is on the eastern shore of Lake Tahoe.

38. *Leptothorax nevadensis* subsp. *rudis* subsp. nov.

Worker. Length 2.6–3.3 mm.

Distinctly larger and more robust than the typical *nevadensis* and much more coarsely sculptured. Funicular joints 2–8 distinctly broader in proportion to their length. Head subopaque, finely and densely longitudinally rugose, with punctate interrugal spaces and sometimes with an interrupted shining median line. Frontal area shining, very finely striated. Mandibles coarsely punctate, striated at their bases. Thorax and petiole coarsely punctate-rugose, the rugae on the pleurae and often also on the pro- and epinotum longitudinal, on the mesonotum often vermiculate. Declivity of epinotum densely punctate and as opaque as the remainder of the thorax (more shining in the typical form). Postpetiole densely punctate and opaque. The epinotal spines are much stouter and blunter, and the petiolar node is much less compressed anteroposteriorly, its posterior surface being much more convex than in typical *nevadensis*. The color is considerably darker, the body being castaneous, with the head and gaster, except its incisures, blackish, the mandibles, clypeus, antennae and legs yellowish brown, the femora infuscated in the middle. Pilosity as in the typical form.

Female (deälated). Length: 3.5 mm.

Smaller than the female of typical *nevadensis*, with longer and more slender epinotal spines and the funicular joints 2–8 shorter. Sculpture of the head, thorax and petiole a little coarser. Petiolar node like that of the worker. In the typical form it is much compressed anteroposteriorly and has a sharp, transverse superior border. There is very little difference in color between the two forms.

Described from numerous workers and a single female taken from small colonies nesting under the edges of stones in Tenaya Canyon, Yosemite Valley, Cala. Seven workers from Angora Peak, 8600 ft., near Lake Tahoe, Cala., though differing in certain details of sculpture are nevertheless referable to this subspecies.

39. *Leptothorax rugatulus* Emery.

South Dakota: (Rergande).

Colorado: (Pergande); Cheyenne Canyon, near Colorado Springs (Wheeler).

Washington: Seattle (T. Kincaid).

Montana: Helena (W. M. Mann).

Study of much more material of this form and its varieties than I possessed when I wrote my "Revision of the North American Ants of the Genus Leptothorax" (Proc. Acad. Nat. Sci. Phila., 1903, pp. 215–260) convinces me that *rugatulus* is really a distinct species, as Emery maintained, and not a subspecies of *curvispinosus* Mayr. The latter is the most generally distributed and abundant *Leptothorax* in the Eastern and Central States as far west as Missouri, but *rugatulus* and its varieties are confined to the Western States. The two forms also differ in habits, *rugatulus* and its varieties nesting under stones and *curvispinosus* in hollow twigs and old galls.

40. *Leptothorax rugatulus* var. *cockerelli* Wheeler.

New Mexico: Las Vegas Hot Springs, type locality (T. D. A. Cockerell).

Arizona: Miller, Carr and Ramsay Canyons, Huachuca Mts. (Biedermann, Mann and Wheeler).

41. *Leptothorax rugatulus* var. *mediorufus* var. nov.

Worker. Length 2.5–3 mm.

A little larger, much more coarsely sculptured and of a much deeper color than the var. *cockerelli* and the subsp. *annectens.* Upper surface of head and gaster black; mandibles, clypeus, antennæ, thorax, petiole, postpetiole and a spot at the base of the first gastric segment ferruginous red; margins of gastric segments yellowish; legs yellowish brown, the femora infuscated in the middle. Rugosity of head, thorax and petiole coarse; head but slightly shining; thorax, petiole and postpetiole opaque, densely punctate. Declivity of epinotum transversely rugulose. Epinotal spines a little stouter but not more curved than in the typical *rugatulus.*

Female. Length 3.5 mm.

Decidedly larger than the female of *cockerelli,* with the body very dark brown, the antennæ, mandibles, legs and incisures of the gaster light brown. Surface of head, thorax and pedicel quite as coarsely sculptured as in the worker and much less shining than in *cockerelli* and the typical *rugatulus.* Wings whitish hyaline, with nearly colorless veins and pale brown stigma.

Described from many workers and three females from several colonies found near Lake Tahoe, Cala. (Tallac, Glen Alpine) and about Camp Curry in the Yosemite Valley. A series of workers and two winged females taken by Prof. J. C. Bradley at Volcano Creek in Southern California also belong to this form.

42. *Leptothorax rugatulus* Emery subsp. *annectens* Wheeler.

The four cotype workers taken at Boulder by Rev. P. J. Schmitt remain the only specimens I have seen of this form.

43. *Leptothorax rugatulus* subsp. *brunnescens* subsp. nov.

Worker. Length 1.6–2 mm.

Decidedly smaller than the preceding forms of the species and much more feebly sculptured, so that the surface of the head, thorax and pedicel is distinctly shining. The epinotal spines are shorter than their distance apart at the base, very feebly curved and slightly deflected at their tips. The postpetiole is nearly twice as broad as long, with prominent, but rounded anterior corners. The petiolar node seen from above is as broad as long, and as in the other forms broader behind than in front. In the other forms the segment is considerably longer. The color is dull yellowish brown, with the upper surface of the head and gaster, the summits of the petiolar and postpetiolar nodes and the middle portions of the femora darker brown.

Described from twenty workers taken by Dr. S. J. Hunter in Creede County, Colorado, at an altitude of 8844 ft.

44. *Leptothorax (Mychothorax) muscorum* Nyl. var. *sordidus* Wheeler.

Colorado: Boulder (P. J. Schmitt).

45. *Leptothorax (Mychothorax) muscorum* var. *septentrionalis* var. nov.

Worker. Length 2.5 mm.

Resembling the var. *sordidus*, but with the head and gaster dark brown or black above, the paler portions of the body of a deeper and more ferruginous red and the rugosity and punctuation decidedly coarser, so that the head, thorax, petiole and postpetiole are nearly opaque. The petiolar node is blunter and more rounded above in profile than in *sordidus* and the typical *muscorum* of Europe.

Female. Length 2.9 mm.

Dark brown; head black; venter yellowish, much of the pleurae lower surfaces of petiole and postpetiole, mandibles, legs and antennae, except the clubs, paler brown. Thorax subopaque, densely punctate, pronotum transversely, mesonotum longitudinally rugulose. Wings white, with colorless veins and brown stigma. Pilosity much as in the worker.

Male. Length 2.6–3 mm.

Black, legs and incisures of gaster dark brown. Wings as in the female. Head, thorax, petiole and postpetiole subopaque, densely rugulose-punctate. Pilosity abundant, short and white.

Described from numerous specimens of all three phases, which I took from several colonies nesting under stones on the southern slope of Tunnel Mt. at Banff, Alberta, a series of workers collected by Dr. C. Gordon Hewitt at Sulphur Springs, near Banff and a few workers which I found in the Yoho Pass, near Emerald Lake, British Columbia. At first sight this ant closely resembles *L. rugatulus* var. *mediorufus* but it can be readily distinguished by the feeble transverse mesoëpinotal impression and faintly indicated promesonotal suture.

46. *Leptothorax (Mychothorax) acervorum* Mayr subsp. *canadensis* Provancher.

Washington: Olympia (T. Kincaid).

Colorado: Florissant (Wheeler); Ward and Pikes Peak, 10,000 ft. (T. D. A. Cockerell).

Utah: Little Willow Creek, Salt Lake Co. (R. V. Chamberlin).

Maine: Orono (H. H. Severin).

New Hampshire: Franconia and summit of Mt. Washington (Mrs. A. T. Slosson).

This species was originally described from Canada. The following smaller and darker variety is also widely distributed through the Canadian Zone but seems to be rare and local:

47. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *convivialis* Wheeler.

Wisconsin: Milwaukee, type locality (Wheeler).

New Mexico: Beulah, 8000 ft. (F. W. P. Cockerell); Top of Las Vegas Range, 11,000 ft. (T. D. A. Cockerell).

Connecticut: Colebrook (Wheeler).

Nova Scotia: Digby (J. Russell).

Newfoundland: Spruce Brook.

This form was described as *L. canadensis* subsp. *obscurus* by Viereck in a paper on the Hymenoptera of Beulah New Mexico (Trans. Amer. Ent. Soc. 29, 1903) which appeared a month later than my revision of the species of *Leptothorax*.

48. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *kincaidi* Pergande.

Four workers and a deälated female taken by Mr. F. H. Whitney on the Upper Kugarok River, north of Nome, Alaska (65°!) are clearly referable to this variety, originally described from Metlakahtla. Both phases are larger (worker 3 mm.; female 4 mm.) and more coarsely sculptured than our other North American forms. In my workers the reddish brown thorax has a black crescent on the pronotum and the upper surface of the epinotum and the petiole and postpetiole are of the same color. The epinotal spines are long, thick and blunt, the antennal scapes reach only a little more than half the distance between the eyes and posterior corners of the head. The hairs on the legs are short, coarse and suberect.

49. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *yankee* Emery.

British Columbia: Glacier (Wheeler); Rogers Pass and Prairie Hills, Selkirk Mts. and Carbonate (J. C. Bradley).

Alberta: Lake Louise and Moraine Lake, Valley of the Ten Peaks (Wheeler).

Colorado: Boulder (P. J. Schmitt and W. W. Robbins).

South Dakota and Utah: (Emery).

Michigan: Washington Harbor, Isle Royale (O. McCreary).

At Glacier and Lake Louise I found several colonies of this ant nesting under stones in rather damp places. The worker form, originally described from South Dakota, Utah and Colorado, differs from the typical *canadensis* and the preceding varieties in its somewhat finer sculpture and paler color, the mandibles, antennae, except their clubs, the thorax, pedicel and legs being reddish brown or red, the femora infuscated in the middle. The epinotal spines are rather long and pointed. The male measures 4 mm. and is distinctly larger than the worker (2.5–3 mm.) and only slightly smaller than the typical *acervorum,* from which it is almost indistinguishable. Comparison with Swiss specimens shows that the American variety has a darker pterostigma and smaller epinotal protuberances. The female is somewhat smaller and darker than the female of the typical *acervorum*.

50. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *calderoni* Forel.

I have taken numerous workers and females of this form in the type locality (about Lake Tahoe, Cala.), where it is common in little nests in the bark of large pine logs and stumps, often in plesiobiosis with *Camponotus herculeanus* var. *modoc*. The worker has the color of the var. *yankee*. According to Forel the antennal scapes are longer than in *canadensis,* reaching nearly to the posterior corners of the head, but my specimens show considerable variation in this particular. Nor do I find that the worker *calderoni* is larger than the European *acervorum,* though it is larger than the var. *yankee*. My workers vary considerably in size, from 2.5–3.5 mm. The main difference which I detect between *yankee* and *calderoni* is in the proportions of the promesonotum, the length of this region in the latter form between the cervical ridge of the pronotum and the mesoëpinotal suture being more than $1\frac{1}{2}$ times the breadth of the pronotum through the humeri, whereas in *yankee* it is distinctly less. Sculpture and pilosity are very similar in the two forms.

51. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *crassipilis* subsp. nov.

Worker. Length: 2.5–3 mm.

Differing conspicuously from the preceding forms of *acervorum* in sculpture and pilosity. The surface of the head, thorax, petiole and postpetiole is distinctly though feebly shining owing to the more superficial punctuation. The rugae on the head and thorax are much more distinct, coarser and further apart. The blunt, erect hairs on the upper surface of the body, especially on the head, thorax and pedicel are much longer, coarser and glistening white. The hairs on the legs seem also to be somewhat coarser than in the various forms of *canadensis.* The spines of the epinotum are scarcely more than half as long as their distance apart at the base, acute and rather slender. The antennal scapes reach about half way between the eyes and the posterior corners of the head and the basal funicular joints are distinctly shorter and more transverse than in *canadensis* and its varieties. Color dark brown or castaneous, head and sometimes the gaster darker and more blackish; mandibles, antennae and legs pale brown; middle portions of femora, but not the antennal clubs, infuscated.

Female. Length: 3.5 mm.

Very similar to the worker, the rugosity of the head and thoracic dorsum and the pilosity of the head and thorax even a little coarser and more conspicuous. Body uniformly castaneous, except the pale incisures of the gaster. Wings grayish hyaline, veins pale brown, pterostigma dark brown.

Male. Length 3–3.5 mm.

Much smaller than the male of *canadensis* and *acervorum.* Dark brown; head black, mandibles and legs pale brown, tarsi paler. Wings white, with pale brown veins and stigma. Sculpture of head and thoracic dorsum distinctly more superficial than in *canadensis* var. *yankee* and *calderoni*, the head, especially, more shining. Pilosity not more abundant, but paler.

Described from numerous specimens of all three phases taken from small colonies under stones in several localities (Manitou, Cheyenne Creek, Red Rock Canyon, Williams Canyon) near Colorado Springs during July and August, 1903. This form is so distinct that it might be regarded as an independent species, but as it has the shape of *acervorum* and the median impression of the clypeus I prefer for the present to regard it as a subspecies.

52. *Leptothorax* (*Mychothorax*) *emersoni* Wheeler subsp. *glacialis* Wheeler.

Colorado: Florissant 8500 ft. (Wheeler).

As I have shown (Bull. Wis. Nat. Hist. Soc. 5, 1907, p. 78 *et seq.*), this subspecies lives in the colonies of *Myrmica brevinodis* var. *subalpina* in much the same manner as the typical *emersoni* of New England and Canada lives with *M. brevinodis* var. *canadensis.*

53. *Leptothorax* (*Mychothorax*) *emersoni* subsp. *hirtipilis* subsp. nov.

Worker. Length 2.5 mm.

Differing from the typical *emersoni* and the preceding subspecies in the following characters: the mesoëpinotal constriction is more pronounced, the pro- and mesonotum being somewhat more convex and at a higher level than the base of the epinotum. The sculpture is much coarser, the rugae on the head being very sharply defined even on the occiput and posterior corners; on the thoracic dorsum the rugae are vaguely longitudinal. The head, thorax and petiole are decidedly opaque. The pilosity is much coarser and more abundant, especially on the thorax and legs. The color is a little darker than that of *emersoni* and *glacialis*, with only the anterior border of the gaster yellowish.

A single specimen taken from a nest of *Myrmica brevinodis* var. *subalpina* on the southern slope of Tunnel Mt., at Banff, Alberta. This shows that the habits are symbiotic as in the other forms of the species.

54. *Leptothorax* (*Mychothorax*) *hirticornis* Emery subsp. *formidolosus* Wheeler.

Colorado: Flagstaff Mt., Boulder Co. (T. D. A. Cockerell).

South Dakota: Hill City (Pergande Coll. Nat. Mus.).

55. *Aphaenogaster subterranea* Latr. subsp. *occidentalis* Emery.

Washington: Pullman, type locality (Pergande); Pullman and Wawawai (W. M. Mann); Almota (A. L. Melander); Olympia (T. Kincaid).

Oregon: Ashland (W. Taverner).

California: Pacific Grove, Mt. Tamalpais, Yosemite and Lake Tahoe (Wheeler); Palo Alto and King's River Canyon (H. Heath); Corte Madera Creek, Santa Cruz Mts. (W. M. Mann); Mountain View.

Idaho: Moscow (J. M. Aldrich).

Utah: East Mill Creek, Salt Lake Co. (R. V. Chamberlin).

Colorado: Cheyenne Canyon near Colorado Springs and Boulder (Wheeler).

Montana: Helena (W. M. Mann).

British Columbia: Dog Lake, Penticton (C. G. Hewitt).

This subspecies is extremely common in both the Coast Range and the Sierras of California from sea-level to an elevation of 6000 ft. It appears to be equally common in Oregon and Washington but is much more sporadic in the other localities cited.

56. *Aphaenogaster subterranea* subsp. *valida* Wheeler.

Recently described from Cheyenne Canyon, near Colorado Springs.

57. *Aphaenogaster subterranea* subsp. *valida* var. *manni* var. nov.

Worker. Length 4–5 mm.

Differing from the typical *valida* in color, the body and antennae being yellowish brown throughout, the mandibles, clypeus, and legs paler and clearer yellow. The sculpture of the epinotum and mesopleuræ and sides of the pronotum much feebler and the upper surface of the pronotum more shining.

Numerous workers from Pullman, Washington, (W. M. Mann). Other workers from the same locality but from different nests have the head and gaster darker than the thorax and thus represent transitions to the typical *valida*.

58. *Aphaenogaster subterranea* subsp. *borealis* Wheeler.

Recently described from worker specimens taken by Prof. J. C. Bradley at Lardo, Kootenay Lake, British Columbia. A number of workers taken by Dr. C. G. Hewitt at Arrowhead Lake, British Columbia, though slightly darker, are also referable to this subspecies.

59. *Aphaenogaster patruelis* Forel.

Known only from the Island of Guadeloupe off the coast of Lower California.

60. *Aphaenogaster patruelis* var. *bakeri* Wheeler.

This variety was taken several years ago on Catalina Island off the coast of Southern California by Prof. C. F. Baker.

61. *Aphaenogaster patruelis* var. *carbonaria* Pergande.

According to Forel, this form, originally described as a species, is merely a somewhat darker and more coarsely sculptured variety of *patruelis*. The types were taken by Eisen at Sierra Laguna and El Chinche in Lower California.

62. *Aphaenogaster mutica* Pergande.

Known from Lower California, Northern Mexico and Western Texas.

63. *Aphaenogaster texana* Emery.

Recorded from Texas, Arizona and Kansas.

64. *Aphaenogaster texana* var. *furvescens* Wheeler.

Described from the Huachuca Mts., Arizona.

65. *Aphaenogaster fulva* Roger subsp. *aquia* Buckley var. *rudis* Emery.

Several workers, a deälated female and a male of this form were taken by me at Boulder, Colo. July 29, 1906. Like other forms of the species it is common in the Central and Eastern States and reaches the western limit of its range on the eastern slopes of the Rocky Mts.

66. *Aphaenogaster fulva* subsp. *aquia* var. *azteca* Emery.

A form closely related to the preceding but more coarsely sculptured. It was described from Mexico without more precise locality.

67. *Aphaenogaster uinta* sp. nov.

Worker. Length 4.5–5 mm.

Head subrectangular, a little longer than broad, as broad in front as behind, with straight sides and rounded posterior corners and with a distinct pit-like impression in the median line on the vertex between the eyes. These are rather large, convex and situated near the median transverse diameter of the head. Mandibles with straight external borders and convex tips, with three larger apical and several more indistinct basal teeth. Clypeus moderately convex, its anterior border rather deeply notched in the middle. Frontal area distinct; frontal carinae small, erect in front, continued behind into slightly converging ridges. Antennae slender; scapes surpassing the posterior border of the head by somewhat less than $\frac{1}{6}$ their length, curved at the base and slightly thickened at the apex; funiculi with a distinct 4-jointed club; first funicular joint longer than second; joints 2–7 subequal, nearly twice as long as broad, joints 8–10 subequal, less than twice as long as broad, terminal joint distinctly longer. Thorax slender; pro- and mesonotum together forming a convex, hemispherical mass, the anterior border of the mesonotum not projecting above the pronotum, sloping and concave behind. Seen from above the mesonotum is narrow, more than twice as long as broad. Mesoëpinotal constriction rather deep. Epinotum long, somewhat less than twice as long as high, in profile with the base perfectly straight and horizontal, and on each side passing into the declivity, with a rectangular projection, representing the spine of other species. Seen from above the dorsal surface of the base is longitudinally impressed in the middle. Petiole short, its peduncle shorter than the node, which is nearly as high as the length of the segment, conical in profile, with strongly concave anterior and abrupt and feebly convex posterior slope. Seen from above the petiole through the node is about one half as broad as its length. Postpetiole shaped like the petiolar node in profile but somewhat lower, from above a little longer than broad and a little broader than the petiole. Gaster rather large, broadly elliptical. Legs moderately slender; spurs distinct on the median and hind tibiae.

Shining; mandibles densely striated, clypeus and antennal scapes finely longitudinally rugulose. Anterior portion of head to a short distance behind the eyes finely punctate and feebly longitudinally rugose. Posterior portion of head more shining, more sparsely and more superficially punctate. Pro- and mesonotum above smooth and shining, feebly shagreened; pleurae and epinotum punctate-rugulose and subopaque, the rugules on the base of the epinotum very fine, transverse. Petiole and postpetiole finely shagreened, feebly shining. Gaster very smooth and shining, superficially but distinctly shagreened, with sparse piligerous punctures. Legs moderately shining, finely shagreened.

Hairs yellowish; coarse, sparse and erect on the body, very short and subappressed on the antennal scapes and legs.

Yellowish red; legs more yellowish; gaster black or very dark brown, posterior borders of segments and anal region testaceous.

Female. Length about 7 mm.

Head scarcely longer than broad, distinctly broader behind than in front, with more rounded posterior corners than in the worker. Thorax through the wing-insertions as broad as the head through the eyes. Epinotum with two strong, acute spines, which are as long as broad at their bases. In profile the declivity is concave and distinctly shorter than the nearly straight, sloping base. Both the petiole and postpetiole, with their nodes, more compressed anteroposteriorly than in the worker. Wings rather long (8 mm.).

In sculpture, pilosity and color resembling the worker, but the head more opaque and more rugose behind. Pronotum transversely rugulose, mesonotum and scutellum and portions of mesopleurae smooth and shining; epinotum subopaque, its base transversely, its sides longitudinally rugulose. Mesonotum with three elongate brown blotches. Wings grayish hyaline, with pale brown veins and conspicuous dark brown stigma.

Male. Length nearly 4 mm.

Head a little longer than broad, flattened, rounded behind, with straight, marginate occipital border, large eyes and ocelli and very short cheeks. Mandibles small, with 5 or 6 teeth. Clypeus convex, its border straight and entire in the middle. Antennae slender, scapes as long as the first and second funicular joints together; joints of club strongly constricted at their proximal ends so that this portion of the antennae is moniliform. Mesonotum convex, distinctly longer than broad; scutellum as long as broad; base of epinotum straight in profile, gradually sloping to the posterior swellings which are feebly developed, rounded above and angulate behind, but not pointed. Nodes of petiole and postpetiole low and rounded. Legs slender.

Mandibles subopaque, very finely and indistinctly striate; clypeus smooth and shining; head subopaque, obscurely punctate-rugulose. Remainder of body smooth and shining, except the posterior swellings of the epinotum, which are subopaque and irregularly rugose.

Pilosity much as in the worker, but the long, erect hairs on the gaster finer.

Piceous; clypeus and legs pale brown; head black; mandibles and antennae sordid yellow. Wings as in the female, but a little more whitish.

Described from seventeen workers, one female and one male taken by Dr. R. V. Chamberlin at East Mill Creek, Salt Lake County, Utah.

This form is evidently quite distinct from any of our other North American species of *Aphaenogaster* though most closely related to *subterranea.* The worker and female of *uinta* can be distinguished from the various forms of this species by their color, the greater length of the scapes and funicular joints and the much larger eyes, the worker by its more rectangular head, peculiar epinotum, more conical postpetiole and larger gaster, the female by its smaller head, shorter epinotal spines and much darker pterostigma, the male by the very different epinotum, longer mesonotum, more shining and much less densely sculptured head and the paler body and appendages.

68. *Stenamma nearcticum* Mayr.

This species is known only from male and female specimens. What Mayr took to be the worker belongs to *brevicorne.* The types were from California. My collection contains a male and female from Corvallis, Oregon.

69. *Stenamma brevicorne* Mayr subsp. *diecki* Emery.

British Columbia: Yale, type locality (G. Dieck).
Illinois: Rockford (Wheeler).

Pennsylvania: Beatty (P. J. Schmitt).
Connecticut: Colebrook (Wheeler).

70. *Stenamma brevicorne* subsp. *heathi* Wheeler.
California: King's River Canyon (H. Heath).
Easily recognized by its uniform light red color and coarse sculpture.

71. *Stenamma brevicorne* subsp. *sequoiarum* subsp. nov.

Worker. Length 3–3.3 mm.

Resembling the subsp. *heathi* but larger and of the same color as *diecki*, with even coarser sculpture than the former, the rugae on the head being stronger and those on the pronotum very coarse and sparse, more longitudinal and less reticulate. The postpetiole is evenly and sharply longitudinally rugose and the rugae at the extreme base of the gaster are very distinct. The base of the epinotum is coarsely and vermiculately rugose. Head broader and the postpetiole distinctly longer than broad, its node lower and less convex than in *diecki* and *heathi*. The basal funicular joints are broader and slightly longer than in the other subspecies of *brevicorne*. Hairs on the body less abundant and more appressed, especially on the gaster and tibiae. Surface of the head, thorax and pedicel distinctly shining as in *heathi* and somewhat more opaque than in *diecki*.

Female (deälated). Length 3.6 mm.

Resembling the worker; larger than the female *diecki*, with more robust thorax and the whole body paler and more reddish. The sculpture is coarser, the upper surface of the mesonotum and scutellum more sharply longitudinally rugose. Funicular joints longer, hairs on the legs more appressed.

Described from a single female and numerous workers taken from several colonies nesting under stones among the large red-wood trees in Muir Woods on Mt. Tamalpais, Cala. A series of workers taken by Prof. H. Heath several years ago at Pacific Grove, Cala. appear to connect this subspecies with *diecki*. They are somewhat smaller than the specimens of *sequoiarum* and have a more convex postpetiole, which is longitudinally striate only on the sides and smooth and shining above. The head is somewhat more elongate and the basal funicular joints narrower and shorter. Both these specimens and those of *sequoiarum* may represent the unknown workers of *S. nearcticum*.

72. *Stenamma manni* Wheeler.

Known only from worker and female specimens taken by Dr. W. M. Mann at Chico in Hidalgo, Mexico.

Dolichoderinae.

73. *Liometopum apiculatum* Mayr.

Mexico: Volcan de Colima, 7500 ft. (C. H. T. Townsend); Pinos Altos, Chihuahua and Ciudad de Durango, 8100 ft. (cited in Biol. Centr. Amer.); Guerrero Mill, Hidalgo, 9000 ft. (W. M. Mann).

Arizona: Huachuca Mts. 5000 ft. (Biedermann).

New Mexico: Las Vegas (Wheeler); Las Vegas Hot Springs, 6226 ft. and Romeroville (T. D. A. Cockerell); High Rolls, 6550 ft., Alamogordo, 4320 ft. (G. V. Krockow) and Beulah, 8000 ft. (H. Viereck).

Texas: Paisano Pass, 5079 ft. and Fort Davis, 5400 ft. (Wheeler).

Colorado: Canyon City, 5329 ft. and Cotopaxi 6371 ft. (P. J. Schmitt); Manitou and Cheyenne Canyon, 7000 ft. (Wheeler).

This ant seems always to be associated with live-oaks. Its habits, so far as I have been able to observe them, have been described in my paper "The North American Ants of the Genus Liometopum" (Bull. Amer. Mus. Nat. Hist. 21, 1905, pp. 321–333).

74. *Liometopum apiculatum* subsp. *luctuosum* Wheeler.

Colorado: Cheyenne Canyon, 7000 ft. near Colorado Springs, type locality (Wheeler).

Arizona: Grand Canyon 4000–7050 ft. and Prescott, 5320 ft. (Wheeler).

California: Baldy Peak, San Gabriel Mts., 6500 ft. (Brewster, Joos, and Crawford); Tenaya Canyon, Yosemite, 5000 ft. (Wheeler).

Though rarer and more sporadic than the typical form of the species and *occidentale,* this subspecies seems to have a wide range. The few colonies seen in the Yosemite were running on pine trees. This seems to confirm the opinion I advanced in 1905 that *luctuosum* is definitely associated with conifers.

75. *Liometopum occidentale* Emery.

California: San Jacinto, 1533 ft. (type locality); Mariposa 1962 ft.; Pasadena and Yosemite 4000 ft. and Wawona (Wheeler); Baldy Peak, San Gabriel Mts. (Brewster, Joos and Crawford); Claremont (C. F. Baker and Wheeler); Coalinga, below 500 ft., Fresno County, Ontario and Alpine (J. C. Bradley).

Oregon: Corvallis.

I have recently found a few specimens of the hitherto unknown female and male of this ant from San Jacinto, Cala., in the Pergande

Collection (U. S. Nat. Mus.). They differ so much from the corresponding phases of *apiculatum* that *occidentale* can no longer be regarded as a mere variety of the former, but must be elevated to specific rank. Comparison of the female and male of *occidentale,* however, with those of the European *L. microcephalum* may show closer affinities with this species, as a variety of which Emery originally described *occidentale.* The following descriptions are drawn from two females and a male:

Female. Length 10–10.5 mm.; wings 11.5 mm.

Much smaller than *apiculatum* and with much shorter wings (length of *apiculatum* 12–14 mm.; wings 17–18 mm.) and differing also in the following characters: The head, excluding the mandibles, as long as broad; with the scapes not reaching to the posterior corners, the frontal groove very sharp and distinct and extending from the frontal area to the anterior ocellus. Thorax through the wing insertions not broader than the head, the flattened mesonotum distinctly longer than broad. Surface of the body shining, though coarsely shagreened and sparsely punctate. Hairs short and rather numerous, but much shorter and less abundant than in *apiculatum.* Color ferruginous brown, gaster darker, lower surface of head, thoracic sutures and legs paler and more yellowish. Wings whitish hyaline, not infuscated as in *apiculatum,* with paler veins and brown stigma and subcostal vein.

Male. Length 9 mm.; wings 10 mm.

Differing from the male *apiculatum* in its smaller size, shorter wings and antennae (length of *apiculatum* 9–11 mm.; wings 14 mm.), with the wings pale like those of the female, the gaster, legs, genitalia and antennae reddish brown and the hairs, especially on the head, thorax and legs conspicuously shorter and less abundant. The volsellae of the genitalia are shorter and their tips slightly crenate along the dorsal border, whereas this border is smooth in *apiculatum.*

L. occidentale is very abundant among live oaks at low altitudes in the Coast Range of California but less common in the Sierras. It seems not to occur on their eastern slopes, judging from my inability to find it in the Lake Tahoe Region. Only a few colonies were seen in the Yosemite; at Wawona it was more abundant.

76. *Tapinoma sessile* Say.

Washington: Almota (A. L. Melander); Orcus Island, San Juan Island, Pullman and Ellensburg (W. M. Mann); Rock Lake.

California: San Jose and Palo Alto (H. Heath); Lompoc, Mt. San Jacinto, Harris, Humboldt County and summit of Mt. Wilson (J. C.

Bradley); Whittier and Azusa (W. Quayle); Yosemite and Lake Tahoe (Wheeler).

Washington: "Throughout the state" (W. M. Mann).

Idaho: Market Lake (J. M. Aldrich).

Nevada: King's Canyon, Ormsby Co. (C. F. Baker).

Colorado: Ward 9000 ft. (T. D. A. Cockerell); Buena Vista, Salida, Colorado Springs, Florissant and Boulder (Wheeler); Eldora, 8600 ft. and Swift Creek, (W. P. Cockerell); Creede Co. 8844 ft. (S. J. Hunter); Tolland and Boulder, 5000–10500 ft. (W. W. Robbins).

New Mexico: Las Vegas (Wheeler); Harvey's Ranch, Las Vegas Range, 10,000 ft. (Ruth Raynolds); Manzanares (Mary Cooper); Pecos and Albuquerque (T. D. A. Cockerell).

Arizona: Grand Canyon (Wheeler); Huachuca Mts., 5000 ft. (Biedermann and Wheeler).

Texas: Jefferson (E. S. Tucker).

Montana: Flathead Lake (C. C. Adams).

British Columbia: Golden (W. Wenman); Emerald Lake (Wheeler).

Alberta: Banff (Wheeler).

This ant is equally abundant and widely distributed in the whole region between the area covered by this list of localities and the Atlantic sea-board. It is an essentially eurythermal species, always nesting under stones, logs or bits of wood in open places. The large number of specimens which I have accumulated show considerable variations in size and coloration and some minor structural differences, so that one or more subspecies or varieties may have to be recognized when the material is more closely studied.

CAMPONOTINAE.

77. *Prenolepis imparis* Say.

California: Piedmont, Alameda County and Berkeley (J. C. Bradley); Point Loma, near San Diego (P. Leonard); Palo Alto and San Jose (H. Heath); Santa Inez Mts. near Santa Barbara, Pasadena, San Diego, Claremont, San Gabriel Mts. and Yosemite Village (Wheeler).

Nevada: Ormsby County (C. F. Baker).

Oregon: Ashland (W. Taverner).

Arizona: Grand Canyon, 3670 ft. (Wheeler); Ramsay Canyon, Huachuca Mts. (W. M. Mann).

Colorado: Cheyenne Mt. near Colorado Springs (Wheeler).

Mexico: Colima, 7500 ft. (C. H. T. Townsend).

This species is also very common throughout North America east of the Mississippi River from Southern Ontario to St. Augustine, Florida, where it was taken by Prof. C. T. Brues. It belongs properly to the transition zone and is, according to my observations, always associated with oak trees. In the Eastern States the var. *testacea* Emery descends into the Upper and Lower Austral. It is one of the most abundant ants in the sandy pine-barrens of New Jersey and at low altitudes in the mountains of North Carolina. As Emery has shown, the European *nitens* Mayr is merely a subspecies of *imparis* with darker wings in the male and female (Deutsch. Ent. Zeitschr. 1910). This author has called attention to the remarkable distribution of the species, the subsp. *nitens*, the only known Old World form, being confined to Carinthia, Styria, the Balkan Peninsula, Asia Minor and the eastern shores of the Black Sea, whereas the typical form of the species has a very wide range in North America.

78. *Lasius niger* L. var. *sitkaënsis* Pergande.

Alaska: Sitka, type locality (T. Kincaid).

British Columbia: Glacier (Wheeler); Dowie Creek and Rogers Pass, Selkirk Mts. (J. C. Bradley).

Manitoba: Aweme (N. Criddle); Treesbank (C. G. Hewitt).

Ontario: Kenora (J. C. Bradley).

Washington: Olympia (T. Kincaid); Seattle (Wheeler); Pullman (W. M. Mann).

Oregon: Corvallis.

Idaho: Troy (W. M. Mann); Moscow (J. M. Aldrich).

Montana: Yellow Bay, Flathead Lake (C. C. Adams).

South Dakota: Elk Point (E. N. Ainslie).

California: Giant Forest, 6500 ft. (J. C. Bradley); Lake Tahoe, 6000–7000 ft. and Camp Curry and Glacier Point, 4000–8000 ft. Yosemite (Wheeler); King's River Canyon (H. Heath).

Colorado: Florissant, 8200 ft., Cheyenne Canyon and Williams Canyon, 8000 ft. (Wheeler); Denver (E. S. Tucker); Platte Canyon, 10,000 ft. and Rico, 10,000 ft. (E. J. Oslar).

Nova Scotia: Port Maitland (W. Reiff).

Maine: South Harpswell (Wheeler); Reed's Island, Penobscot Bay (A. C. Burrill).

As shown by the list of localities, this form is very widely distributed through the Canadian zone. The worker and female are larger than any of our other North American forms of *L. niger* (3.5–4 mm. and

8–9 mm. respectively) and quite as large as those of the typical Eurasian form of the species. The worker has the same abundant pubescence and erect hairs on the legs and scapes, but in the female the hairs are less abundant. The ocelli of the worker are very distinct. The body is yellowish brown, with the upper surface of the head, thorax and gaster darker and the appendages a little paler. The wings of the female measure 10–10.5 mm. and are uniformly pale yellowish brown, whereas those of the typical *niger* are colorless. The male *sitkaënsis* is scarcely smaller than the male *niger* dark brown and with the wings faintly tinged with the same color. This form passes by gradations into the smaller and darker variety, *neoniger* Emery and also approaches the true *niger* and the subspecies *alienus*. Thus the workers of some of the colonies found at Lake Tahoe and in the Yosemite are much like the European *niger*, whereas others are smaller and, except for their pilosity, might be confounded with large forms of *alienus* or its variety *americanus* Emery.

79. *Lasius niger* var. *neoniger* Emery.

Alberta: Banff (Wheeler).

California: Lake Tahoe (Wheeler).

South Dakota: Elk Point (C. N. Ainslie).

Colorado: Broadmoor, near Colorado Springs, Florissant and Salida (Wheeler); Ward, 9000 ft. and Steamboat Springs (T. D. A. Cockerell).

New Mexico: Viveash Ranch, 9000 ft. (Cockerell).

Washington: Pullman (W. M. Mann and R. W. Doane); Union City (J. C. Bradley).

This variety is also common in cool woods or at higher altitudes throughout the maritime provinces of Canada and the Eastern and Central States as far south as the Black Mts. of North Carolina. The worker and male measures only 2–2.5 mm., the female 6–7 mm. The wings of the female measure 8–9 mm. and both in this sex and the male are clear and hyaline. The body of the worker and female is dark brown or black and the erect hairs on the dorsal surface and on the legs and scapes are abundant and conspicuous.

80. *Lasius niger* subsp. *alienus* Forster var. *americanus* Emery.

Alberta: Banff (J. C. Bradley).

British Columbia: Glacier, Field and Emerald Lake (Wheeler); Carbonate (J. C. Bradley).

Colorado: Denver (E. Bethel); Silverton, 10,000 ft. (E. J. Oslar);

Manitou and Salida (Wheeler); Boulder (T. D. A. Cockerell); Canyon City (P. J. Schmitt).

Idaho: Julietta (J. M. Aldrich); Troy (W. M. Mann).

Utah: East Mill Creek, Salt Lake Co. (R. V. Chamberlin).

New Mexico: Gallinas Canyon (T. D. A. Cockerell); Las Valles (Mary Cooper).

Arizona: Grand Canyon, 7000 ft. (Wheeler).

California: Glacier Point, 8000 ft., Yosemite (Wheeler).

Very common throughout the Middle and Eastern States as far south as Georgia. That this variety should be attached to the European subsp. *alienus* and not to the typical *niger* is evident from the absence of erect hairs on the legs and antennal scapes and the sparse pilosity of the body, and also from the fact that the female, especially in the mountains of the western states, is indistinguishable in stature from the female of the true *alienus*, measuring nearly 8 mm., with wings 9–10 mm. long, although the females of the typical eastern *americanus* are often not more than 5–5.5 mm., with wings not exceeding 8 mm. Both forms may occur in some of the middle-western states, e. g. in Illinois and Wisconsin. The western form might be distinguished as a variety, for which the name *alieno-americanus* would be appropriate. The males, too, vary greatly in size and the differences of color among the workers of different colonies are considerable. In the Eastern States the workers of a form always found in dry sandy fields are very pale, almost drab-colored, whereas in adjacent woodlands the workers are always darker, varying from dark brown to black. Future study on the basis of a large amount of material will probably lead to the distinction of a number of forms of *L. niger* in North America, where the species is more variable than it is in Europe.

81. *Lasius* (*Formicina*) *brevicornis* Emery.

Montana: Elkhorn (W. M. Mann).

Colorado: Cheyenne, Canyon, near Colorado Springs (Wheeler).

New Mexico: San Geronimo (Mary Cooper).

This species, which is very common under stones on dry sunny hill slopes in New England and New York, is rare in the Western States.

The worker specimens from Colorado and New Mexico approach those of the following subspecies in the shape of the petiolar node and in having slightly smaller eyes than the typical form, but the differences are not sufficient to justify a new varietal name.

82. *Lasius* (*Formicina*) *brevicornis* subsp. *microps* subsp. nov.

Worker. Differing from the typical *brevicornis* in the much smaller and more nearly circular eyes which have only 11–13 ommatidia. The funicular joints of the antennae are slightly longer. The petiole is narrower, with straight sides and broadly and feebly emarginate superior border, whereas the typical *brevicornis* has the node entire with more rounded sides and border. The pubescence on the head and thorax is distinctly shorter so that the surface is more shining and the color of the body is not a pure but a more brownish yellow.

Described from numerous specimens taken from a large colony under a stone at Yosemite Village, 4000 ft., Cala.

83. *Lasius* (*Formicina*) *flavus* Fabr. subsp. *nearcticus* Wheeler.

Colorado: Topaz Butte, 9000 ft., near Florissant, and Salida (Wheeler).

This form is common throughout the Eastern and Middle States but evidently rare in the arid west, probably because of its preference for damp, shady situations. In the eastern states and Canada I have found it only in moist woods.

84. *Lasius* (*Formicina*) *flavus* subsp. *claripennis* subsp. nov.

Worker. Length 2.6–3 mm.

Similar to the typical *flavus* of Europe and the subsp. *nearcticus* but averaging smaller and with the antennae shorter, the scapes scarcely surpassing the posterior corners of the head. The color of the body is brownish yellow as in the true *flavus* and not pale yellow with whitish gaster as in *nearcticus*. The eyes are distinctly smaller and much as in the European subsp. *myops* Forel.

Female. Length 7 mm.

Differing from the female *flavus* and *nearcticus* in the shorter antennae, the scapes of which reach only to the posterior corners of the head. The wings are not infuscated at the base as in these forms, but clear and hyaline throughout and the posterior portion of the head and thoracic dorsum is dark brown, much darker than in *nearcticus* and perceptibly darker than in the typical *flavus*.

Male. Length 3 mm.

Differing from the male *flavus* and *nearcticus* in having slightly shorter antennae, in its smaller size and the darker, nearly black color of the body.

Described from numerous workers, four females and six males taken Aug. 20th from several colonies nesting under stones on the southern slope of Tunnel Mt. at Banff, Alberta. Several workers received from Farewell Creek, Southern Saskatchewan (E. G. Titus), three workers from Pullman, Washington, and a series of workers, males and females from Creede Co., Colo., 8844 ft. (S. J. Hunter) also belong to this subspecies. It is evidently quite distinct from the other forms of *flavus*. It resembles the subspecies *myops* in preferring hot, stone-covered slopes to moist, shady places as a habitat.

85. *Lasius* (*Formicina*) *umbratus* Nyl. subsp. *subumbratus* Viereck.

New Mexico: Beulah, 8000 ft., type-locality (T. D. A. Cockerell).

Colorado: Cheyenne Canyon near Colorado Springs, Williams Canyon near Manitou, and Boulder (Wheeler); Canyon City (P. J. Schmitt).

Utah: Little Willow Canyon, Salt Lake County (R. V. Chamberlin).

Arizona: Williams, 7000 ft. (Wheeler).

California: Angora Peak, near Lake Tahoe, 8000 ft. (Wheeler).

Ontario: Ottawa (Wheeler).

Quebec: Hull (Wheeler).

Maine: Reed's Island, Penobscot Bay (A. C. Burrill).

Nova Scotia: Digby (J. Russell); Bedford (W. Reiff).

The list of localities shows that this form has a very wide range. It is the most boreal of our forms of *umbratus* and is confined to the Canadian Zone.

86. *Lasius* (*Formicina*) *umbratus* subsp. *mixtus* Nyl. var. *aphidicola* Walsh.

This form, so abundant in many localities east of the Rocky Mts., is very rare further west. During the summers of 1903 and 1906 I found a few colonies near Florissant and Colorado Springs, Colorado. They nest by preference in moderately moist, shady places. This probably accounts for their almost complete absence from the arid portions of the country.

87. *Lasius* (*Formicina*) *umbratus* subsp. *vestitus* Wheeler.

Known only from a female specimen taken by Prof. J. M. Aldrich at Moscow, Idaho.

88. *Lasius* (*Formicina*) *humilis* sp. nov.

Worker. Length 1.5–1.7 mm.

Head as broad as long, a little narrower in front than behind, with broadly and feebly excavated posterior border and feebly and regularly convex sides. Eyes very small, somewhat larger than in the typical *brevicornis*, flat, with only about six ommatidia in their greatest diameter. Antennae slender; scapes extending beyond the posterior corners of the head, funiculi scarcely enlarged at their tips; joints 2–3 as broad as long, all the other joints distinctly longer than broad, the ninth and tenth being nearly 1½ times as long as broad. Clypeus very bluntly subcarinate. Frontal area large, triangular. Palpi rather long, the six joints of the maxillary pair gradually decreasing in length towards the tip as in other members of the subgenus. Thorax rather short, the pro- and mesonotum together as long as the epinotum; mesonotum as long as broad, the promesonotal suture not deeply impressed; mesoëpinotal constriction short but moderately deep; epinotum in profile with the convex base about ¼ as long as the flat, sloping declivity. Petiole narrow and rather high, much compressed anteroposteriorly, with flat anterior and posterior surfaces, straight, nearly subparallel sides and rather sharp, entire and evenly rounded superior border. Gaster broad, flattened dorsoventrally.

Surface shining; mandibles finely striated; remainder of body very finely and superficially shagreened.

Pubescence and hairs pale yellow, the former appressed, abundant and moderately long on the body and appendages, the latter blunt and erect, very sparse on the head, more numerous on the thoracic dorsum and still more abundant on the gaster.

Pale yellow; head and antennae a little darker; mandibles with reddish borders and teeth.

Female. Length 3.5 mm.

Head subrectangular, slightly broader than long, with rather deeply and broadly excised posterior border and straight cheeks. Eyes large, convex, more than half as long as the cheeks. Antennal scapes surpassing the posterior corners of the head by about ⅙ their length; all the funicular joints distinctly longer than broad. Thorax not broader through the wing-insertions than the head through the eyes, flattened above; mesonotum nearly as long as broad. Petiole with more convex sides and blunter superior border than in the worker, this border feebly emarginate in the middle in some specimens. Wings rather long.

Sculpture and pubescence much as in the worker, erect hairs on the thorax and gaster apparently less numerous and conspicuous.

Color like that of the worker, but the occipital portion of the head, the pro- and mesonotum, scutellum and dorsal surface of the gaster pale brown. Wings grayish, not infuscated at their bases, with pale brown veins and stigma.

Described from nine workers and three females taken by Dr. W. M. Mann at Pyramid Lake, Nevada.

This ant might be regarded as an extreme subspecies of *umbratus*, but the worker and female are decidedly smaller even than the corresponding phases of the eastern subsp. *minutus* Emery, the female, indeed, being smaller than that of any other North American *Lasius*. The different proportions of the funicular joints seem to justify a specific name, as the joints 9 and 10 are very distinctly longer. The eyes of the worker are smaller, the promesonotal suture is much less deeply impressed and the mesonotum much less convex and projecting, the mesoëpinotal impression shallower than in *umbratus* and the petiolar border not so sharp.

89. *Lasius* (*Acanthomyops*) *occidentalis* Wheeler.

Colorado: Colorado Springs and Ute Pass (Wheeler).

New Mexico: Pecos and Trout Spring, Gallinas Canyon (T. D. A. Cockerell); Manzanares (Mary Cooper); Albuquerque (W. H. Long).

This small species is not known to occur east of the Rocky Mts. and appears to have the most limited range of any species of the subgenus.

90. *Lasius* (*Acanthomyops*) *murphyi* Forel.

North Carolina: Morganton, type locality (Forel).

New York: Cold Spring Harbor, L. I. and Bronxville (Wheeler).

Ontario: Toronto.

Colorado: Boulder (P. J. Schmitt and T. D. A. Cockerell).

Montana: Helena (W. M. Mann).

This ant appears to belong to the warmer and dryer portions of the Transition Zone and to be rare in all parts of its range. It forms large colonies under stones in open woods.

91. *Lasius* (*Acanthomyops*) *latipes* Walsh.

California: Mt. Tamalpais (C. G. Hewitt); Mountain View.

Washington: Pullman and Wawawai (W. M. Mann); Almota (A. L. Melander); Rock Lake.

Idaho: Julietta (J. M. Aldrich).

Utah: Salt Lake Co. (R. V. Chamberlin).

Colorado: Manitou and Florissant (Wheeler); Boulder (P. J. Schmitt and T. D. A. Cockerell).

New Mexico: Las Vegas (T. D. A. Cockerell); Albuquerque (W. H. Long).

Illinois: Rockford (Wheeler).

Pennsylvania: Enola.

New Jersey: Weasel Mt. and Lakehurst (Wheeler).

New York: Bronxville and White Plains (Wheeler).

Connecticut: Colebrook (Wheeler).

Massachusetts: Franklin and Boston (Wheeler); Needham (A. P. Morse).

As shown by the list of localities, this species has a very wide range, from Boston to San Francisco. It is rather sporadic and nests under large stones in dry fields and pastures.

92. *Lasius* (*Acanthomyops*) *interjectus* Mayr.

Washington: Pullman (W. M. Mann).

Colorado: Manitou, Cheyenne Canyon and Colorado Springs (Wheeler); Longmont (P. J. Schmitt).

New Mexico: Las Valles (Mary Cooper).

Montana: Flathead Lake (C. C. Adams).

Specimens of all three phases from these localities are indistinguishable from those of the Central and Eastern States where the species is much more common. It nests in rather dry, sunny places. The basal border of the mandibles in the worker and female, is distinctly denticulate, a peculiarity which I have not observed in our other species of the subgenus *Acanthomyops*.

93. *Lasius* (*Acanthomyops*) *interjectus* subsp. *californicus* subsp. nov.

Worker. Length 2.6–3 mm.

Much smaller than the worker of the typical form, which measures 4–5 mm., with the basal border of the mandibles very indistinctly denticulate and the funicular joints of the antennae a little shorter and the scapes much shorter, extending only slightly beyond the posterior corners of the head. The sides of the head are distinctly less convex. The mesoëpinotal constriction is much feebler and the base of the epinotum much less convex, narrower and rounded. Color, sculpture and pilosity much as in the typical form.

Female. Length 7.5 mm.

Somewhat smaller than the typical form and of a different color, the thorax, petiole and gaster being rich reddish castaneous, the head, base of first gastric segment and the appendages red. The infuscation of the bases of the wings is scarcely perceptible. The petiole is much broader and more deeply excised than in the female of the typical *interjectus* and the funicular joints of the antennae are distinctly shorter.

Described from eleven workers taken by myself from a single colony in Palmer's Canyon, San Gabriel Mts., near Claremont, Cala., at an altitude of about 2000 ft., and a single female from the same mountains (F. Grinnell).

94. *Lasius* (*Acanthomyops*) *interjectus* subsp. *coloradensis* subsp. nov.

Worker. Very similar to the preceding subspecies and of the same size but with distinctly larger eyes and finer and conspicuously more abundant erect hairs on the head, thorax and especially on the gaster. The proportions of the scape and funicular joints and the shape of the thorax and petiole are the same as in *californicus.*

Female. Length 4.5–5 mm.

Decidedly smaller than the female of *californicus,* with the head as well as the thorax deep castaneous. Mandibles, antennae and legs brownish yellow, the femora somewhat infuscated in the middle. Wings grayish hyaline, not darker at the base, the veins and stigma pale. Petiole less deeply emarginate above and much narrower than in *californicus.* Erect hairs on body more abundant.

Male. Length 3 mm.

Much smaller and more pilose than the male of the typical *interjectus,* with uniformly grayish, hyaline wings. The superior petiolar border is noticeably blunter and the funicular joints are distinctly shorter.

Described from a dozen workers and as many females taken by myself at Manitou, Colo. (type locality), Aug. 9, 1903, six workers, seven females and two males taken by Mr. E. Bethel at Denver, a single deälated female taken by Prof. Cockerell at Las Vegas, New Mexico and three workers from Manzanares in the same state (Mary Cooper).

95. *Lasius* (*Acanthomyops*) *interjectus* subsp. *arizonicus* subsp. nov.

Worker. Length 3.5–4.5 mm.

Larger than *californicus* and *coloradensis* but somewhat smaller than the typical *interjectus* and of a slightly paler yellow color. The proportions of the antennal scape and funicular joints and the shape of the thorax are much the same as in *interjectus,* but the petiole is much smaller and narrower. The eyes are considerably larger and more convex. The erect hairs on the head, thorax and gaster are much fewer, there are usually no hairs on the gula, and the pubescence on the body and especially on the gaster is much shorter than in typical *interjectus* so that the surface appears very glabrous and shining.

I took many workers of this species in Miller Canyon, Huachuca Mts., 5000 ft., during November 1910 and received additional material from Mr. Biedermann, who took it in Carr Canyon, and from Dr. W. M. Mann who took it in Ramsay Canyon in the same mountain range. The subspecies is very easily recognized by its larger eyes, peculiar pilosity and very smooth surface.

96. *Lasius* (*Acanthomyops*) *interjectus* subsp. *mexicanus* Wheeler.
I have recently described this subspecies from specimens of all three phases taken by Dr. Mann at Guerrero Mill in the State of Hidalgo, Mexico, at an altitude of 8500–9000 ft.

97. *Lasius* (*Acanthomyops*) *claviger* Roger.
I have seen only a few specimens of this very common eastern species from the west, a worker taken at Old Pecos Pueblo, New Mexico, by Prof. Cockerell and several workers and females taken by Dr. Mann at Helena, Montana. In Massachusetts and Connecticut *claviger* is the most abundant *Acanthomyops*. The small subspecies of *interjectus* described above, show that the species is by no means so distinct from *claviger* as we had supposed. The small form described by Emery from the Eastern States as *claviger* var. *subglaber* should be regarded as a subspecies. I have taken all three phases of it at Rockford, Ill., and on Great Blue Hill, near Boston, Mass., and have seen specimens from the District of Columbia (cotypes from Pergande), Delaware Co., Pa. (Cresson) and Algonquin, Ill. (W. A. Nason). At first sight this form closely resembles *interjectus* subsp. *coloradensis* in size, but the workers and females of this form are much more pilose, the antennal funiculi are distinctly less clavate and the female is much darker.

98. *Formica sanguinea* Latr. subsp. *subnuda* Emery.
British Columbia: Field and Emerald Lake (Wheeler).
Alberta: Lake Louise and Banff (Wheeler).
California: Fallen Leaf Lake and Glen Alpine Springs, near Lake Tahoe (Wheeler); Sugar Pine, Madera County (J. C. Bradley).
Idaho: Troy (W. M. Mann).
Washington: Seattle (Wheeler).
Colorado: San Juan Mts., 12,000 ft., Bullion Peak, Park Co., 13,000 ft., and Gibson's Gulch, Hayden Peak, 10,000 ft. (E. J. Oslar); Tolland (W. W. Robbins).

In my "Revision of the Ants of the Genus Formica" I have cited this ant from many other localities from British Columbia to Connecticut. It is very widely distributed in the Transition and Canadian Zones. Of the numerous colonies seen in California and British America during the summer of 1915 few contained slaves (*F. fusca*).

99. *Formica sanguinea* subsp. *puberula* Emery.

Arizona: Graham Mts. (E. G. Holt).

Recorded from various localities in South Dakota, Colorado, Utah, Washington, Montana, New Mexico, Texas, Missouri and Illinois.

100. *Formica sanguinea* subsp. *obtusopilosa* Emery.

An imperfectly known subspecies described from a single worker taken in New Mexico.

101. *Formica munda* Wheeler.

Known from several localities in Colorado, New Mexico, South Dakota, Montana and Alberta where it occurs below elevations of 7000 ft.

102. *Formica munda* var. *alticola* var. nov.

Worker. Length 4.5–5 mm.

Differing from the typical *munda* in having the red portions of the body of a much deeper shade, and the petiole and dorsal portion of the head infuscated. The erect hairs on the head and thorax are distinctly more abundant than in *munda.*

Described from seventeen specimens taken by Mr. E. J. Oslar in Jefferson County, Colorado at an altitude of 9500 ft. This is clearly an alpine variety. One of the specimens is a pseudogyne, with very convex pro- and mesonotum and well-developed scutellum and metanotum, but without traces of wings.

103. *Formica emeryi* Wheeler.

Known only from Broadmoor, near Colorado Springs, Colo.

104. *Formica manni* Wheeler.

Idaho: Boise (A. K. Fisher).

Originally described from several localities in Washington and Owen's Lake, California.

105. *Formica perpilosa* Wheeler.

Occurring at rather low elevations in Colorado, New Mexico, Arizona, Western Texas and Northern Mexico.

106. *Formica bradleyi* Wheeler.

Colorado: San Miguel, 12,000 ft. and Bullion Peak, Park Co. 12,000 ft. (E. J. Oslar).

Montana: Missoula.

Previously known only from workers taken at Georgetown, Colo. and Medicine Hat, Alberta. It is evidently an exclusively alpine species. The two specimens from Missoula are females. They measure nearly 7 mm. and are colored like the worker, red throughout, except the posterior borders of the gastric segments which are fuscous. The surface of the body is subopaque. The petiole is cuneate in profile, broad below, with flat anterior and posterior and rather sharp, emarginate superior border. The notch in the middle of the anterior clypeal border is very distinct. The wings are grayish hyaline, with brown stigma and yellowish brown veins.

107. *Formica rufa* L. subsp. *obscuripes* Forel.

British Columbia: Glacier (Wheeler).

Alberta: Banff (Wheeler).

Manitoba: Treesbank (C. G. Hewitt).

Montana: Beaver Creek (S. J. Hunter).

Wyoming: Cheyenne (Fanny T. Hartman): Rock River (S. J. Hunter).

Colorado: Creede, 8844 ft. (S. J. Hunter); Tolland (W. W. Robbins); Jefferson (A. K. Fisher).

California: Tallac, Lake Tahoe (Wheeler).

Washington: The eastern part of the state (W. M. Mann).

The attempts in my "Revision" to dissipate the confusion in regard to our American forms of *rufa,* prove to have been unsuccessful and I must here make another attempt. I believed that I could recognize four forms of this species, the subsp. *obscuripes* Forel, the subsp. *aggerans* (a new name for Emery's *rubiginosa* (*nom. praeocc.*)), the var. *melanotica* Emery and a var. *whymperi* described by Forel as belonging to *obscuripes* but at the time unknown to me. I have since found this variety in British Columbia and am able to state that it does not belong to *rufa* or *obscuripes* but is a distinct species of the *microgyna* group and is very close to the form I described as *F. adamsi* (*vide infra*). The var. *melanotica* is a very definite color variety of *obscuripes* and need not be discussed. Doubt remains then only in regard to the typical *obscuripes* and *aggerans.* Although I studied much material from a number of localities I was unable to distinguish these forms satisfactorily for the reason that both were inadequately described by Emery and Forel and because the latter published conflicting descriptions of *obscuripes*. His original description (C. R. Soc. Ent. Belg. 1886, p. 2) runs as follows: "Ouvrière. Long. 3.8–8 mm. Très semblable a la *F. rufa i. spec.* d'Europe. Mais elle est plus petite; les grandes ouvrières sont d'un rouge plus clair et presque ou entièrement sans tache sur la tête et le thorax, tandis que les pattes et l'ecaille sont d'un brun noirâtre. Les petites ouvrières sont beaucoup plus foncées et tachées de brun sur la tête et le thorax. L'abdomen est mat, noir, et a une pubescence grise un peu plus forte que chez la *F. rufa i. spec.*, tandis que la pilosité est plutôt un peu plus faible.—Green River, Wyoming (Scudder)." Recurring to this form in connection with his description of *whymperi* (Ann. Soc. Ent. Belg. 48, 1904, p. 152) Forel says: "Emery rattache *l'obscuripes* comme variété a *l'obscuriventris*. Mais *l'obscuriventris* est beaucoup plus poilue et a les tibias garnis de poils dressés, ce qui n'est pas le cas de *l'obscuripes*, dont les tibias n'ont qu' une pubescence adjacente et dont le corps n'a que très peu de poils dressés, beaucoup moins que chez la *pratensis* d'Europe et même que chez la *rufa* typique. Je maintiens donc *l'obscuripes* comme race ou sous-espèce distincte."

Finding that there was considerable variation in the pilosity of my series of *rufa* from different colonies and localities and relying on these descriptions, I naturally referred the more pilose forms to Emery's *rubiginosa* and the less pilose forms to Forel's *obscuripes*. Since the publication of my "Revision" Forel returns to the subject with the following statement (Deutsch. Ent. Zeitschr. 1914, p. 619):

"Ich habe leider bei Gelegenheit der Beschreibung dieser Rasse (*obscuripes*) und bei derjenigen der var. *whymperi* For. die Tatsache übersehen, dass die Originaltypen der *obscuripes*, die ich noch in Anzahl besitze, nicht, wie ich angegeben hatte, ohne abstehende Haare, sondern sehr deutlich, obwohl meistens spärlich abstehend behaart sind. Die Behaarung wechselt, wie Wheeler von *aggerans* angibt, ziemlich stark bei den verschiedenen Individuen und ich hatte bei der Beschreibung ein solches angesehen, wo sie fast oder ganz fehlten, ebenfals ist der Hinterleib matt mit feiner rauher Pubescens, so dass ich mit dem besten Willen keinen Unterschied zwischen *obscuripes* und *aggerans* finden kann und diese beiden Formennamen als synonym betrachten muss; auch die Haare des Hinterleibs sind gleich. Dagegen bleiben die v. *melanotica* Em. und *whymperi* For. (letztere ohne abstehende Haare) bestehen.—Lake Tahoe, Kalifornien."

As I collected many specimens of this ant at Lake Tahoe I am undoubtedly in possession of specimens which Forel now pronounces to be his *obscuripes*. These also undoubtedly belong to the form I called *aggerans* in my "Revision." They are much more hairy than the European *rufa* and if the Wyoming types of *obscuripes* had been like these it is difficult to see how Forel could have overlooked their striking pilosity and have penned the two descriptions above quoted. Pending a more exhaustive study I am willing, however, to attribute both forms to *obscuripes* and to regard it as a subspecies in which there is considerable variability in pilosity (as in the typical *rufa* of Europe). But as the term *aggerans* was suggested to replace Emery's *rubiginosa* (a preoccupied name), we have still to determine what Emery meant by this form. As he possessed cotypes of *obscuripes* when he wrote the description of *rubiginosa*, the latter was evidently something different. After carefully rereading Emery's description I conclude that he must have had a distinct variety of *obscuriventris* which I believe I am now able to recognize (*vide infra* under the forms of *truncicola*).[3]

108. *Formica rufa* subsp. *obscuripes* var. *melanotica* Emery.
Colorado: Boulder (W. W. Robbins).
Washington: Tacoma (C. C. Adams).
Alberta: Pincher and Lethbridge (C. G. Hewitt).
Manitoba: Treesbank (C. G. Hewitt).

This form, which I have recorded also from Wisconsin, Illinois, South Dakota, Nebraska, Wyoming, Washington and British Columbia, is merely a very dark form of *obscuripes* with only the head red in the largest workers. The true *obscuripes* does not range eastward of the Rocky Mountains.

109. *Formica truncicola* Nyl. subsp. *integroides* Emery.
California: Lake Tahoe (Wheeler).

Recorded previously from several localities both in the Coast Range and in the Sierras of California. The colonies which I saw in large pine logs and stumps near Tallac and Fallen Leaf Lake were very populous like those of the vars. *haemorrhoidalis* and *coloradensis* in the Rocky Mts. The nests were banked with considerable quantities of vegetable detritus.

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[3] Since this paragraph was written I have found two worker cotypes of *F. obscuripes* from Green River, Wyo. in the Pergande Collection (U. S. Nat. Mus.). They have very distinct suberect hairs on the legs, but the pubescence on the gaster seems to be shorter and finer than in workers from Lake Tahoe.

110. *Formica truncicola* subsp. *integroides* var. *tahoënsis* var. nov.

Worker. Length 4–6 mm.

Resembling the subsp. *integroides* but differing in its decidedly smaller average size, in the shape of the head, larger eyes, pilosity and coloration. The head is narrower in front with much less convex, anteriorly converging cheeks and straight posterior border, so that it is distinctly trapezoidal with less rounded posterior corners. Surface of body opaque, mandibles lustrous, frontal area shining. The erect hairs are extremely sparse on the head and thorax, usually restricted to a few scattered hairs on the clypeus and upper surface of the head. Pubescence grayish, abundant, especially on the gaster. Gaster black, with red anal region. In large workers the head, thorax, petiole and appendages are red, with the apical half of the antennal funiculus infuscated, but often even the largest workers have the ocellar triangle, the upper portion of the petiole and a spot on the pro- and mesonotum blackish and the coxae, femora and tibiae dark red or fuscous. The infuscation of the red portions of the body may be even more extensive in small individuals.

Female. Length 8.5–9.5 mm.

Differing from the female *integroides* in lacking erect hairs on the upper surface of the thorax and pedicel, the gula and posterior portions of the head. The head, thorax, petiole and appendages are uniformly red in some specimens, in others the metanotum and posterior portion of the scutellum are black and there may be three elongate black blotches on the mesonotum or only a single anteromedian blotch. Wings grayish hyaline, with their basal halves distinctly infuscated; veins and stigma brown.

Described from numerous workers and four deälated females taken from several colonies near Lake Tahoe, Cala. (Tallac, Glen Alpine Springs, Fallen Leaf Lake, Angora Peak), and a single female taken by Prof. C. F. Baker in Ormsby County, Nevada. In the almost complete absence of erect hairs on the head, thorax and petiole, this variety resembles the var. *haemorrhoidalis,* but the worker averages distinctly smaller, has a differently shaped head and the smaller and even some of the larger workers are more or less spotted with black. It is less hairy than the typical *integroides* and the gaster is darker. Like the other forms of the subspecies it forms large colonies in stumps and logs which it banks with much vegetable detritus.

111. *Formica truncicola* subsp. *integroides* var. *propinqua* var. nov.

Worker. Very similar to the preceding both in size and coloration, but with more numerous erect hairs on the head, gula, thoracic dorsum and petiolar border than even in the typical *integroides*, and these hairs are coarse and blunt on the thorax. The head is a little less narrowed in front than in the var. *tahoënsis*, the cheeks feebly convex, the eyes of the same size.

Described from numerous specimens taken from several colonies in the same localities as the var. *tahoënsis*. As the differences of pilosity of these two varieties appear to be constant throughout the colonies, it seems necessary to regard them as distinct. It is not improbable that they really belong to different altitudes, *propinqua* preferring the hot moraine region (6000 ft.) between Fallen Leaf Lake and Lake Tahoe and *tahoënsis* the greater elevations (7000–7500 ft.), but as I did not distinguish the two forms in the field, owing to their great similarity in size and color, I am unable to make a positive statement on this matter.

112. *Formica truncicola* subsp. *integroides* var. *coloradensis* Wheeler.

Colorado: Bullion Peak, Park County 12,000 ft., Gibson's Peak, 10,000 ft. and Wilson Peak, 13,000 ft. (E. J. Oslar); Creede 8844 ft. (S. J. Hunter); Tolland (W. W. Robbins).

Known also from other localities in Colorado, from New Mexico and Idaho.

113. *Formica truncicola* subsp. *integroides* var. *haemorrhoidalis* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter).

This form seems to be more widely distributed than *coloradensis* as it is known to occur in Colorado, South Dakota, Idaho, Nevada and Washington.

114. *Formica truncicola* subsp. *integroides* var. *ravida* Wheeler.

Known only from Elkhorn and Helena, Montana (W. M. Mann).

115. *Formica truncicola* subsp. *integroides* var. *subfasciata* var. nov.

Worker. Length 6–8.5 mm.

Averaging considerably larger and apparently much more feebly polymorphic than the typical *integroides*. Erect hairs on the upper surface of the head, thorax and petiole much less numerous. The red color of the body is paler and clearer and without traces of infuscation even in the smaller workers. Gaster with the base of each of the segments dull red. Tips of antennal funiculi scarcely infuscated. Anus red as in the other forms of the subspecies.

Described from numerous workers taken by Mr. Fordyce Grinnell in Mill Creek Canyon, Wilson Peak, 7500 ft., San Bernardino Mts., Southern California.

116. *Formica truncicola* subsp. *integra* Nyl. var. *subcaviceps* var. nov.

Worker. Length: 6–7.5 mm.

Differing from the typical *integra* in the following characters: Posterior border of head in largest workers more deeply excavated, almost as deeply as in *F. exsectoides* Forel. Whole body and especially the gaster more opaque. Gula and posterior corners of head with numerous, delicate, short, erect hairs. Smallest workers distinctly infuscated, entirely dark brown. Median workers with darker legs and petiolar border.

Male. Length 7 mm.

Differing from the male *integra* in having the petiole more compressed, with sharp, broadly excavated superior border, the head, thorax and petiole covered with abundant, short, delicate, black hairs and in the coloration of the legs and wings. The femora are black, the tibiae and metatarsi yellow, with indications of infuscation in the middle of the fore and middle tibiae. Wings distinctly paler than in the typical *integra.*

Described from a single male and three workers from Medford, Oregon (C. M. Keyes) and two dozen workers taken by Dr. C. G. Hewitt at Dog Lake, Penticton, British Columbia. Six workers taken by Dr. W. M. Mann on San Juan Island, Washington, belong to the same variety but have the upper border of the petiole sharper and more compressed anteroposteriorly.

117. *Formica truncicola* subsp. *mucescens* Wheeler.

Colorado: various localities between 7000 and 8000 ft.

118. *Formica truncicola* subsp. *obscuriventris* Mayr.

Montana: Flathead Lake (C. C. Adams).

Also known from the Eastern and Central States, Ontario, Colorado and British Columbia.

119. *Formica truncicola* subsp. *obscuriventris* var. *aggerans* Wheeler.

British Columbia: Emerald Lake (Wheeler); Carbonate, Columbia R. 2600 ft. (J. C. Bradley).

Utah: Promontory Point (A. Wetmore).

Series of workers from these localities agree perfectly with Emery's very brief description of the var. *rubiginosa*. The only difference I can detect between this form and the typical *obscuriventris* is the greater infuscation of the thorax and petiole of even the largest workers. Emery records the form from Nebraska, Colorado and Dakota.

120. *Formica foreliana* Wheeler.

Known only from the Huachuca Mts., Arizona, where it was taken by Mr. C. R. Beidermann at altitudes between 4500 and 5600 feet.

121. *Formica ciliata* Mayr.

Colorado: West Cliff, 7864 ft. (T. D. A. Cockerell).

Recorded from various localities in Colorado and Montana.

Several workers taken by Mr. E. J. Oslar in the San Miguel Mts. of Colorado at an elevation of 11,000 ft. seem to belong to this species, but the head is covered with short erect hairs and not naked as in typical ciliata. As there is a possibility that these specimens may represent a new species with aberrant female form like *ciliata, comata, criniventris,* etc., I await further material before introducing another name.

122. *Formica comata* Wheeler.

Known from Colorado and South Dakota.

123. *Formica criniventris* Wheeler.

Recorded from Boulder, Colo. and Helena, Montana.

124. *Formica oreas* Wheeler.

Taken in various localities in Colorado and New Mexico.

125. *Formica oreas* Wheeler var. *comptula* Wheeler.

Known from Pullman, Washington and Elkhorn, Montana.

126. *Formica dakotensis* Emery.

Alberta: Banff (Wheeler).

Colorado: Creede, 8844 ft. (S. J. Hunter).

Previously known from South Dakota, British Columbia and Nova Scotia.

127. *Formica dakotensis* var. *montigena* Wheeler.

Montana: Nigger Hill, Powell Co. (W. M. Mann).

Recorded from Colorado, New Mexico, Montana and Idaho.

128. *Formica dakotensis* var. *saturata* var. nov.

Worker. Length 4.5–5 mm.

Averaging a little smaller than the other forms of the species and of a much deeper color, the head, thorax, petiole and appendages being rich blackish red, nearly as dark as the gaster, the cheeks and anterior portion of the head sometimes a little paler. The pilosity is like that of the typical *dakotensis,* the erect hairs being exceeding scarce on the head and thorax and lacking on the gula.

Described from a dozen workers taken by Dr. W. M. Mann at Helena, Montana.

129. *Formica microgyna* Wheeler.

Known only from Manitou and Florissant, Colo. (7000–8100 ft.).

130. *Formica microgyna* var. *recidiva* Wheeler.

Colorado and New Mexico.

131. *Formica microgyna* subsp. *rasilis* Wheeler.

Colorado: Buena Vista (Wheeler).

Recorded previously from several localities in Colorado, New Mexico, Utah and Washington.

132. *Formica microgyna* subsp. *rasilis* var. *spicata* Wheeler.

Known only from Florissant, Colorado, 8100 ft.

133. *Formica microgyna* subsp. *rasilis* var. *pullula* Wheeler.

Taken at Flathead Lake, Montana, by Prof. C. C. Adams.

134. *Formica microgyna* subsp. *rasilis* var. *nahua* Wheeler.

Taken by Dr. W. M. Mann at Guerrero Mill (9000 ft.) and Velasco in Hidalgo, Mexico.

135. *Formica microgyna* subsp. *rasilis* var. *pinetorum* var. nov.

Worker. Length 3.5–6 mm.

Very similar to the var. *spicata* but differing in the darker, more blackish gaster, its much more abundant, obtuse hairs and the greater tendency to infuscation of the red regions of the body in the large and median workers. In the latter the ocellar region is black and there is a very distinct, elongate triangular black spot on the mesonotum, with dark clouds on the pronotum and occiput. In small workers the infuscation is more extensive on the head and pronotum and the legs and antennae are darker. The red of the body in larger workers is rather pale and yellowish. The erect hairs are coarse and obtuse and are present on the gula, where none appears in *spicata.*

Described from numerous specimens taken from several colonies on Angora Peak, near Lake Tahoe, California, between 7500 and 8600 ft. These colonies were rather populous and were living under stones and logs banked with vegetable detritus.

136. *Formica microgyna* subsp. *californica* subsp. nov.

Worker. Length 3.5–6.5 mm.

Differing from the other forms of *microgyna* in the sculpture of the integument and in pilosity. The surface of the head, thorax and petiole is so finely and superficially shagreened as to be distinctly shining, and the gaster resembles that of *dakotensis* and *obscuriventris* though more opaque. The pubescence is very short and indistinct and there are no erect hairs on the head, thorax and petiole and only a few on the clypeus. The erect hairs on the gaster are blunt, yellow and sparse. Large workers have the head, thorax, petiole and appendages uniformly red, the gaster black; the median workers have traces of infuscation on the ocellar region, and mesonotum. Small workers have the head and petiole above extensively blackened, the thorax clouded with black even on the sides and the coxae and legs, except the knees and tarsi, fuscous. The petiolar node has a sharp border and in many of the small workers is produced upward as a blunt point in the middle.

Described from numerous workers taken at Glen A'pine Springs, near Lake Tahoe, Cala. (6500 ft.). From one colony of this subspecies on July 26 I took a number of diminutive females resembling those of *microgyna* subsp. *rasilis,* but unfortunately the vial containing them was lost.

137. *Formica microgyna* subsp. *californica* var. *hybrida* var. nov.

Worker. Length 3.5–6.5 mm.

Intermediate between the typical *californica* and the var. *pinetorum,* the color and sculpture being that of the former, the pilosity that of the latter, the pubescence, especially on the gaster, being intermediate.

Numerous workers from several colonies found in the same localities as the var. *pinetorum* on Angora Peak near Lake Tahoe. These may represent a true hybrid form but as I have no proof of their genetic origin, I have preferred to give them a varietal name.

138. *Formica whymperi* Forel.

This form, as above stated, was described by Forel as a mere variety of *F. rufa obscuripes*. During August 1915 I found several colonies of it on the shores of Emerald Lake in British Columbia. It evidently belongs to the *microgyna* group and is specifically the same as my *F. adamsi* described from Isle Royale, Mich. The colonies are rather small and nest under stones and logs which they bank with accumulations of vegetable detritus. The worker of the form which I take to be the same as the type is larger than *adamsi*, measuring 3.5–6 mm. The petiole is blunter and thicker and is produced upward in a blunt point, the hairs on the head and thorax are somewhat less numerous, the dark portion of the gaster is black and not dark brown as in *adamsi* and the black markings of the head and thorax are more pronounced and more sharply outlined in the large workers. *F. adamsi* is, therefore, to be retained as a variety of *whymperi*.

139. *Formica whymperi* var. *alpina* Wheeler.

This variety must also be referred to *whymperi*. I have recorded it from Pikes Peak, 10500–11000 ft., (type locality), Troy, Idaho and Cape Breton Island, but further examination leads me to doubt whether the specimens from the two latter localities really belong to this form. I am not even certain that *whymperi* and *microgyna* are specifically distinct. Both of these forms, with their subspecies and varieties constitute a very difficult complex which can be satisfactorily analyzed only with the aid of more material and with a better knowledge of the males and females than we possess at present.

140. *Formica nevadensis* Wheeler.

Known only from a single female taken in Ormsby County, Nevada by Prof. C. F. Baker. As this county is on the eastern shore of Lake Tahoe we might expect the specimen to be the female of one of the three Californian forms of *microgyna* described above, but this cannot be the case owing to the peculiar abundant pilosity on the body and antennal scapes of the Nevada specimen and the very smooth and shining gaster.

141. *Formica exsectoides* Forel var. *hesperia* Wheeler.

Known only from the vicinity of Colorado Springs.

142. *Formica exsectoides* subsp. *opaciventris* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter).

Wyoming: Yellowstone National Park (J. C. Bradley).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

Previously recorded only from Colorado.

143. *Formica ulkei* Emery.

Manitoba: Treesbank (C. G. Hewitt).

Recorded from South Dakota, Illinois, Nova Scotia and New Brunswick.

144. *Formica fusca* L.

British Columbia: Field and Emerald Lake (Wheeler).

Alberta: McLeod and Jasper (C. G. Hewitt); Lake Louise, Moraine Lake in the Valley of the Ten Peaks, and Banff (Wheeler).

Manitoba: Aweme (N. Criddle).

Washington: Mt. Renier (J. C. Bradley).

California: Kern Lake (J. C. Bradley); Lake Tahoe, 6200–9000 ft. (Wheeler); Camp Curry and Glacier Point, Yosemite, 4000–8000 ft. and Muir Woods, Mt. Tamaplais (Wheeler).

Arizona: San Francisco Mts., 12,000 ft. (W. M. Mann).

Colorado: Creede, 8844 ft. (S. J. Hunter); Chimney Gulch, Golden 14,000 ft.; Bullion Peak, Park County, 14,000 ft.; Clear Creek, Jefferson County, 9500 ft. and Wilson's Peak, 12,000–14,000 ft. (E. J. Oslar).

Montana: Flathead Lake (C. C. Adams); Beaver Creek, 6300 ft. (S. J. Hunter).

Wyoming: Yellowstone National Park (J. C. Bradley).

In my "Revision" I have given a long list of localities of this species, which is the most eurythermal and therefore the most widely distributed of all the species of *Formica* in North America as well as in Eurasia. In the Western States it varies considerably in size and pubescence and in the coloration of the legs and antennae, but I deem it inexpedient to give these varieties names at the present time. Many of them seem to represent transitions between the typical form and the following four varieties:

145. *Formica fusca* var. *subsericea* Say.

I am not sure that this form occurs in the Western States. Specimens referred to this variety on account of their more abundant pubescence are cited from Arizona and Colorado in my "Revision."

146. *Formica fusca* var. *argentea* Wheeler.

Oregon: Ashland (W. Taverner).

California: Angora Peak near Lake Tahoe, 7500–8600 ft. (Wheeler).

Washington: Seattle (Wheeler); Pullman (W. M. Mann); Mt. Renier (J. C. Bradley).

Idaho: Boisé (A. K. Fisher).

Arizona: Graham Mts. (E. G. Holt); San Francisco Mts., (A. K. Fisher).

Colorado: Salida (Wheeler).

Widely distributed through the Transition Zone from the Pacific to the Atlantic Coast.

147. *Formica fusca* var. *marcida* Wheeler.

California: Summit of Angora Peak, near Lake Tahoe, 8650 ft. (Wheeler).

I have recorded this variety from British Columbia, Alberta, Manitoba and Washington. It is a small, depauperate, alpine form. On the bare summit of Angora Peak I found it nesting in little craters in spots from which the snow had recently receded (July 26th). The colonies were small and the ants very active. Prof. Bradley took this variety under very similar conditions at Moraine Lake in the Valley of the Ten Peaks, Alberta. The female measures only 6.5 mm. and has the gaster much more pubescent and much less shining than in the typical *fusca*.

148. *Formica fusca* var. *subaenescens* Emery.

California: Angora Peak, Lake Tahoe, 8600 ft. (Wheeler).

Previously recorded from California, Washington, Idaho, Utah, Colorado, New Mexico, Montana, Alberta, British Columbia and portions of the Middle and Atlantic States.

149. *Formica fusca* var. *gelida* Wheeler.

Recorded from Colorado, New Mexico, Arizona, California, Oregon, Washington, Alaska, British Columbia, Alberta and Saskatchewan.

This is an alpine variety, probably the most stenothermal of all the varieties of *fusca*. In my "Revision" I cited it also from Ontario, Quebec, Labrador, Newfoundland, Nova Scotia, Michigan and New Hampshire, but I have recently shown (Psyche, Dec. 1915, p. 205) that the specimens with this more eastern distribution really constitute a distinct variety, which I have described as var. *algida*.

150. *Formica fusca* var. *neorufibarbis* Emery.

British Columbia: Glacier, Field and Emerald Lake (Wheeler).

Alberta: Lake Louise, Moraine Lake in the Valley of the Ten Peaks (Wheeler); Jasper (C. G. Hewitt).

Washington: Mt. Renier (J. C. Bradley).

California: Lake Tahoe, 6000–7000 ft. and Glacier Point, Yosemite (Wheeler).

Previously cited from various localities in South Dakota, Utah, Montana, Idaho, Oregon, Washington, British Columbia and Alberta.

I found many colonies in the localities above recorded and secured all three phases so that I am able to improve on the description given in my "Revision."

The workers vary greatly in size in each colony, from 3.5–5.5 mm. The largest have the head, including the clypeus, palpi and antennae black, with the scapes, cheeks and mandibles deep red or castaneous, the gaster black and shining, with very short grayish pubescence, the thorax, petiole and legs opaque and immaculate red. The medium-sized workers have a black spot on the pro- and one on the mesonotum; the smallest workers have the whole thorax, petiole and legs dark brown. The petiole is broad, much compressed anteroposteriorly, with broadly rounded, rather sharp border.

The female measures 7–8 mm. and is colored like the worker, except that the sides of the pronotum and the pleurae are clouded with fuscous and the metanotum and posterior border of the scutellum and three large, elongate blotches on the mesonotum are black. The thorax is as shining as the head. The petiole is very broad, very much compressed anteroposteriorly, with flat anterior and posterior surfaces and sharp, broadly rounded superior border. Wings clear grayish hyaline with pale brown veins and dark brown stigma.

The male measures 7–7.5 mm. and is larger than the male of *gelida.* It differs also in having the legs rich yellow, with the base of the femora slightly infuscated and the gaster more shining, with much shorter pubescence and much fewer erect hairs on the head and thorax.

This ant nests by preference in old logs in hot sunny places, but both at Lake Tahoe and in British Columbia I often found it nesting under stones. Several pseudogynes were taken in both localities. They are small (3–4 mm.) and have the dorsal surface of the pro- and mesonotum and the scutellum black.

The specimens cited in my "Revision" as belonging to *gelida* from Blue Lake, Humboldt Co., and Alta Peak, Cala. and from Kassiloff Lake, Kenai Peninsula, Alaska, have the color of the var. *neorufibarbis* but the pubescence of *gelida.* They may be regarded as representing a form intermediate between the two varieties. Owing to its constancy and the pronounced variation in size of the workers of the same colony, *neorufibarbis* should, perhaps, rank as a subspecies.

151. *Formica fusca* var. *neoclara* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter); Hall's Valley, Park Co., 10,500 ft. and Gibson's Gulch, Hayden Peak, 12,000 ft. (E. J. Oslar).

Recorded only from localities in Colorado. As I have never seen this ant above 7000–8000 ft. the elevations given on Oslar's labels seem excessive. The variety really belongs to higher levels in what Cockerell calls the "sub-alpine zone."

152. *Formica fusca* var. *blanda* Wheeler.

The types of this variety are from Olympia, Washington. Further study shows that the specimens cited in my "Revision" from Seattle, Wash. and Lemon Cove, Tulare Co., Cala. do not belong to it but are pale forms of *cinerea* (*vide infra*). The two workers from the Yosemite are also doubtful as they may be immature specimens of *fusca* var. *marcida*.

153. *Formica fusca* subsp. *pruinosa* subsp. nov.

Worker. Length 3.5–4 mm.

Differing but little in size in the same colony and allied to var. *neoclara*, but with narrower, less flattened gaster. The petiole is similar, with broad, blunt superior border, nearly always distinctly emarginate in the middle. Head scarcely longer than broad, narrowed in front, with straight sides and posterior border. Eyes rather large. Epinotum obtusely angular, with subequal base and declivity.

Surface of body finely shagreened, uniformly shining, except the clypeus and anterior portion of the head, which are coarsely shagreened and opaque.

Whole body uniformly covered with very short, dense, silvery pubescence. Head with only a few pairs of erect hairs on its dorsal surface, thorax and petiole without any; gaster with short, sparse, obtuse hairs.

Gaster dark brown, head black; clypeus and mandibles dark brown, cheeks yellowish brown; thorax, coxae and legs yellowish or reddish brown, the thorax and coxae spotted with dark brown, the spots sometimes fusing so that only the sutures are yellowish or reddish. Petiole often infuscated above. Antennal scapes and base of funiculi red, the tip darker.

Female. Length 6.5–7 mm.

Color, pilosity and sculpture much as in the worker; frontal area yellowish red; pronotum of the same color, with its posterior border and a few spots on the sides fuscous; remainder of thorax fuscous or blackish, with a few small reddish spots at the anterior end of the mesonotum and on the pleurae. Coxae yellowish red, like the legs. Thorax with erect hairs on the dorsal surface; those on the gaster longer than in the worker and pointed. Petiole broad, much compressed anteroposteriorly, its anterior and posterior surfaces flat, its superior border transverse and emarginate in the middle. Gaster long and narrow, more than twice as long as broad. Wings grayish hyaline, with pale brown veins and dark brown stigma.

Male. Length 7–7.5 mm.

Very similar to the male of the var. *neoclara* but with the coxae and bases of the femora black, the external genitalia more infuscated and the thorax more robust and broader through the mesonotum. Wings like those of the female but with darker veins.

Described from many workers, two males and three females taken from several nests at Emerald Lake, British Columbia, Aug. 12–15 (type locality), a deälated female and several workers from Field, B. C., numerous workers from a single colony which I found at Banff, Alberta and three workers taken at Beaver Creek, Montana (6300 ft.) by Dr. S. J. Hunter.

This form may represent a distinct species, but as the following variety and the var. *blanda* seem to connect it with the var. *neoclara* I have preferred to regard it, at least provisionally, as a subspecies of *fusca*. At Emerald Lake the colonies of *pruinosa* were found only on the open flat delta at the north end of the lake in a rather moist spot traversed by the icy streams from the Emerald Glacier. The nests were peculiar, being small, loose mounds of spruce needles 8 to 12 inches in diameter and of about the same height, built about the trunks of the scattered and stunted bushes. The colonies were very populous. The two seen at Field and Banff were nesting under stones, in the latter locality at the base of Tunnel Mt.

154. *Formica fusca* subsp. *pruinosa* var. *lutescens* var. nov.

Worker. Differing from the typical *pruinosa* in color and in averaging a little smaller. Body and appendages pale brownish yellow, the gaster pale brown, the head behind the frontal area dark brown, the thorax and coxae spotted with pale brown. Antennae scarcely infuscated at the tip. The petiole is narrower and its superior border distinctly blunter than in the typical *pruinosa*, though usually emarginate in the middle. There are no differences in sculpture and pilosity.

Described from numerous workers taken by Dr. W. M. Mann at

Wawawai (type locality), Kiona and Ellensburg, Washington. The specimens from Ellensburg are somewhat darker, with the thorax and petiole uniformly pale brown like the gaster, thus representing a transition to the var. *blanda*.

155. *Formica rufibarbis* Fabr. var. *occidua* Wheeler.

California: Berkeley (Wheeler).

Recorded from many localities in the Coast Range of California and from Wawawai, Washington. As I did not find this ant in the Yosemite or about Lake Tahoe, I infer that it does not occur in the Sierras, at least at elevations above 4000 ft. or east of California.

156. *Formica rufibarbis* var. *gnava* Buckley.

Recorded from various localities in Texas, New Mexico, Arizona, Southern California, Colorado, Utah and Mexico, as far south as the State of Hidalgo. In the northern portion of its range this variety occurs only at low altitudes in warm, shady canyons.

157. *Formica cinerea* Mayr var. *altipetens* Wheeler.

Colorado: Chimney Gulch, Golden, 9500 ft. (E. J. Oslar).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

Previously known from Florissant and Cheyenne Mt., Colo., where I found it at elevations between 7000 and 8200 ft., and Pachuca in Hidalgo, Mexico, 9000 ft.

158. *Formica cinerea* var. *neocinerea* Wheeler.

Illinois: Hyde Park, Chicago (Wheeler).

Recorded from Illinois, Indiana, South Dakota, Colorado and California.

159. *Formica cinerea* var. *canadensis* Santschi.

"*Worker.* Length 4.5–6 mm.

Black. Anterior portion of head, antennae, excepting the terminal funicular joints, legs, excepting the coxae and often the middle of the femora, base of the petiole brownish red. Pubescence a little less abundant than in the type. Epinotum a little more angular. Petiole as in the var. *neocinerea* Wheeler, from which it differs, as also from the var. *altipetens* Wheeler, in the entirely black color of the thorax, which makes it resemble *F. fusca* L. var. *subaenescens* Emery.

Female. Length 9–9.5 mm.

The front of the head is nearly black; all the remainder of the body black; antennae and legs as in the worker.

Canada: Saskatchewan (Frey 1909), five workers and six females."

As I have not seen this variety, I quote Santschi's description (Ann. Soc. Ent. Belg. 57, 1913, p. 435). In certain particulars it seems to resemble the form described below as *F. hewitti*, but I cannot suppose that Santschi would have described this form as a variety of *cinerea*.

160. *Formica cinerea* var. *lepida* Wheeler.

Lower California: La Ensenada (F. X. Williams).

California: Lemon Cove, Tulare Co. and Blue Lake, Humboldt Co. (J. C. Bradley).

Washington: Seattle (T. Kincaid and Wheeler).

I found workers of this variety running on the sidewalks in Seattle. Two deälated females taken in the same city by Kincaid measure nearly 9 mm. They are colored like the workers, with the sutures and parapsidal furrows of the thorax blackish.

161. *Formica cinerea* subsp. *pilicornis* Emery.

California: Jacumba (J. C. Bradley).

Recorded only from numerous localities in the Coast Range of California, from San Francisco to San Diego.

162. *Formica sibylla* Wheeler.

California: Yosemite Valley, from Yosemite Village, 4000 ft., to Glacier Point, 8000 ft., and Tallac, Fallen Leaf Lake and the Moraine east of Angora Peak, near Lake Tahoe (Wheeler).

The types of this interesting species were taken by Prof. C. F. Baker in King's Canyon, Ormsby County, Nevada, on the eastern shore of Lake Tahoe. In the Californian localities above cited I saw numerous colonies, each comprising a rather small number of workers and nesting in craters 6 to 8 inches in diameter in sandy soil fully exposed to the sun. The workers, which run very rapidly, were seen outside the nests only during the early morning and late afternoon hours of the hot days of July and August. I failed to secure the hitherto unknown female. In life the worker has a peculiar bronzy appearance owing to the dense and rather long grayish yellow pubescence covering the whole body. It is readily distinguished from the forms of *fusca* by the numerous long, erect hairs on the gula, and from the forms of *cinerea* by the absence of erect hairs on the thorax and petiole, their sparse development on the head and gaster, the less angular epinotum, more slender antennae and less curved scapes.

163. *Formica hewitti* sp. nov.

Worker. Length 5–6 mm.

Resembling a large *F. fusca.* Head a little longer than broad, narrower in front than behind, with straight sides and posterior border. Clypeus sharply carinate, its anterior border produced, rounded, entire. Frontal carinae straight, diverging behind. Antennae as in *F. fusca.* Epinotum in profile with subequal, straight base and declivity, meeting at a pronounced obtuse angle. Petiole convex in front, flat behind, very broad, its superior margin straight and truncated, rather sharp, its sides straight, converging below. Gaster large, elongate.

Head in front and thorax coarsely shagreened. Cheeks with elongate punctures. Mandibles lustrous, densely striate-punctate. Frontal area smooth and shining. Thorax opaque; head somewhat shining, especially behind; gaster more shining, very finely shagreened.

Hairs yellowish, erect, sparse on the upper surface of the head, one or more pairs also on the gula. Upper surface of pro- and mesonotum with numerous short, obtuse hairs. Those on the gaster short, obtuse. Legs naked, except for several erect hairs on the flexor surfaces of the femora. Pubescence grayish, short, uniform over the whole body, conspicuously long, but sparse on the sides of the gula.

Black; thorax dark brown or piceous, mandibles, scapes, three basal joints of funiculus, petiole, coxae and legs deep red.

Female. Length 7 mm.

Very similar to the worker in sculpture, color and pilosity, except that the thorax and petiole are black and the mesonotum and scutellum are shining. The petiole is very broad and compressed anteroposteriorly, its superior border rather sharp, straight and entire. The erect hairs on the mesonotum and scutellum are longer than in the worker and pointed. Wings colorless, with pale yellowish veins and pale brown stigma.

Male. Length 6.5 mm.

Closely resembling the male of the typical *fusca,* but the head, thorax and petiole are much more pilose and with a few erect hairs on the gula, the antennae and mandibles are entirely black, as are also the coxae and basal halves of the femora. The wings are clearer, with paler veins and stigma. The petiole is somewhat broader, with a much more compressed and more deeply emarginate superior border.

This species, dedicated to my friend Dr. C. Gordon Hewitt, is described from numerous workers, three females and a single male which I took from several nests under large stones at Emerald Lake (type locality), at Field, British Columbia, and at Laggan, Alberta. Three workers taken by Prof. C. C. Adams at Flathead Lake, Montana, and three workers taken by Dr. S. J. Hunter at Beaver Creek, 6300 ft. in the same state also belong to this species, though the thorax in the former is more reddish and the cheeks and clypeus are deep red. Some workers from a single colony at Field seem to represent a hybrid form between *hewitti* and the typical *fusca.* Only an occasional worker in this series has one or two erect hairs on the gula and the color, pubescence and sculpture is more like certain forms of *fusca* that are intermediate between the type and the var. *subsericea.* Like the following species and *F. sibylla, hewitti* is a puzzling form, since, owing to its peculiar pilosity, it cannot be assigned either to *fusca* or to *cinerea.*

164. *Formica subcyanea* Wheeler.

This species is known only from the state of Hidalgo, Mexico, where it was taken in several localities at elevations of about 9000 ft. by Dr. W. M. Mann. The worker and female are readily distinguished by the very opaque, blue-black surface of the body, entirely black legs, antennae and mandibles and the sparse, erect hairs on the gula.

165. *Formica subpolita* Mayr.

California: Mt. Tamalpais (Wheeler).

Oregon: Ashland (W. Taverner).

The typical form of this species is known only from the coast of California, Oregon, Washington and British Columbia. I failed to find it in the Yosemite or about Lake Tahoe though it ascends to an elevation of at least 6400 ft. in the Coast Range in Southern California.

166. *Formica subpolita* var. *camponoticeps* Wheeler.

California: Yosemite Village, 4000 ft. (Wheeler).

This variety has been recorded from several localities in Washington. The Californian specimens agree in all particulars with the types. Each of the numerous colonies which I found nesting under stones on the dry slope of the canyon wall near Yosemite Village contained workers of very different sizes. These colonies were all much less populous than those of the typical *subpolita,* which prefers a moister environment. In several of the nests I took mature larvae of a Coccinellid (*Brachyacantha* sp.) resembling those which occur in the nests of *Acanthomyops.*

167. *Formica subpolita* var. *ficticia* Wheeler.

Montana: Helena and Elkhorn Mts. (W. M. Mann); Flathead Lake (C. C. Adams); Missoula; Gallatin Co., 6500 ft.

Colorado: Boulder and Buena Vista (Wheeler).

The worker of this variety is much less pilose than the typical *subpolita* and the var. *camponoticeps*. In color it is like the latter, with the upper surface of the head darker, but the head of the largest workers is not so large and rectangular and more like that of the typical form of the species.

168. *Formica* (*Proformica*) *neogagates* Emery.

Utah: Promontory Point (A. Wetmore); Salt Lake (T. H. Parks).

The typical form of this species is widely distributed through the Transition Zone from the New England States to Washington and as far north as Quebec, British Columbia and Alberta, but is not known from California.

169. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* Emery.

Recorded from South Dakota, Colorado and Massachusetts.

170. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* var. *vetula* Wheeler.

California: Lake Tahoe, 6000–8000 ft. and Glacier Point, Yosemite, 8000 ft. (Wheeler).

Alberta: Banff (C. G. Hewitt).

Colorado: Chimney Gulch, Golden 9500 ft., and San Juan Mts. 12,000 ft. (E. J. Oslar).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

More widely distributed than the typical *neogagates*. All the workers and females from California have the scapes even more distinctly hirsute than many specimens from the Eastern and Central States. This ant is very common at Lake Tahoe and is the summer host of *Xenodusa montana* Casey. I found the larvae of this beetle in the nests both at Tahoe and Glacier Point, but failed to find any pseudogynes in these localities. The winter hosts of the *Xenodusa* are *Camponotus herculeanus* var. *modoc* and *C. laevigatus*.

171. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* var. *limata* Wheeler.

Recorded from Colorado and New Mexico.

172. *Formica* (*Neoformica*) *pallidefulva* Latr. subsp. *schaufussi* Mayr var. *incerta* Emery.

This variety, which is very common throughout the Central and Atlantic States, does not extend westward beyond the Eastern slopes of the Rocky Mts. It has been taken in Colorado and New Mexico.

173. *Formica* (*Neoformica*) *pallidefulva* subsp. *nitidiventris* Emery. With the same distribution and western limits as the preceding.

174. *Formica* (*Neoformica*) *pallidefulva* subsp. *nitidiventris* var. *fuscata* Emery.

Also known to occur as far west as New Mexico, but more abundant in the Eastern States.

175. *Formica* (*Neoformica*) *moki* Wheeler.

Recorded from Arizona and Utah.

176. *Polygerus lucidus* Mayr subsp. *montivagus* Wheeler.

Colorado: Colorado Springs (Wheeler).

The typical *lucidus* is known only from the Eastern and Central States as far west as South Dakota.

177. *Polygerus rufescens* Latr. subsp. *breviceps* Emery.

Colorado; Breckenridge (P. J. Schmitt); Florissant, Ute Pass and Colorado Springs (Wheeler).

New Mexico: Old Pecos Pueblo (T. D. A. Cockerell).

Kansas: Osage City (A. C. Burrill).

Illinois: Algonquin (W. A. Nason); Galesburg (M. Tanquary).

Montana: Elkhorn Mts. (W. M. Mann).

California: Santa Cruz (H. Heath); Kern Lake (J. C. Bradley); Fallen Leaf Lake and Glen Alpine, near Lake Tahoe (Wheeler).

Washington: Pullman (W. M. Mann).

In extending to Illinois this subspecies overlaps the distribution of *lucidus* in the Mississippi Valley. My observations on the slave-raids of *breviceps* at Lake Tahoe are published in the Proc. N. Y. Ent. Soc. 24, 1916, pp. 107–118.

178. *Polyergus rufescens* subsp. *breviceps* var. *montezuma* Wheeler.

Mexico: Pachuca in Hidalgo (W. M. Mann).

179. *Polyergus rufescens* subsp. *breviceps* var. *umbratus* Wheeler.

California: Brookdale (H. Heath).

180. *Polyergus rufescens* subsp. *breviceps* var. *fusciventris* var. nov.

Worker. Length 4 mm.

Differing from the typical *breviceps* in its smaller size, more opaque and more coarsely shagreened surface, in having the petiolar node distinctly shorter and more compressed anteroposteriorly and the posterior $\frac{2}{5}$ of the first gastric and the whole of the succeeding segments except the anal region, fuscous.

Described from a single worker taken by Prof. T. D. A. Cockerell at the Half Way House on Pike's Peak, Colo. Several workers taken by Dr. C. G. Hewitt at Treesbank, in Southern Manitoba, though slightly larger, also belong to this variety, which is clearly transitional to the subsp. *bicolor* Wasm. The slaves accompanying these specimens belong to the typical *Formica fusca.*

181. *Polyergus rufescens* subsp. *mexicanus* Forel.

This form, described from Mexico, without precise locality, is hardly distinct from the subsp. *breviceps,* to judge from a couple of cotypes received from Prof. Forel.

182. *Polyergus rufescens* subsp. *bicolor* Wasmann.

Wisconsin: Prairie du Chien, type locality (H. Muckermann).

Illinois: Rockford (Wheeler).

Montana: Yellow Bay, Flathead Lake (C. C. Adams).

183. *Polyergus rufescens* subsp. *laeviceps* Wheeler.

California: Mt. Tamalpais, 1000 ft. (Wheeler); Laws (A. Wetmore).

184. *Camponotus laevigatus* F. Smith.

California: Yosemite Village, 4000 ft. and Tallac, Lake Tahoe (Wheeler).

Washington: Seattle (Wheeler).

Montana: Flathead Lake (C. C. Adams).

Colorado: Meeker (W. W. Robbins).

Previously recorded from numerous localities in California, Oregon, Washington, Idaho, Montana, Colorado, Utah, New Mexico, Arizona and Northern Mexico. At Seattle I found its large colonies in huge pine stumps less than 100 feet above sea-level. Further south it is distinctly boreal, rarely, if ever, descending below 4000–5000 ft. and occurring as high as 11,000 ft. on Alta Peak, Cala.

185. *Camponotus herculeanus* L. var. *whymperi* Forel.

Alaska: Seward (F. H. Whitney).

British Columbia: Emerald Lake and Glacier (Wheeler); Arrowhead (C. G. Hewitt).

Alberta: Laggan, Lake Louise and Moraine Lake (Wheeler).

Washington: Mt. Renier (J. C. Bradley).

Colorado: Bullion Peak, Park Co. 12,000 ft.; Chimney Gulch, Golden, 9500 ft.; San Miguel Mts. 12,000 ft.; Halls Valley, Park Co., 10,500 ft.; Wilson Peak, 13,000 ft. and Bear Creek, Morrison (E. J. Oslar).

Also recorded from many other localities in the Canadian Zone from Alaska and British Columbia to Labrador and Maine.

186. *Camponotus herculeanus* var. *modoc* Wheeler.

California: Nevada Falls, Yosemite (Talcott Williams); Yosemite Village 4000 ft. to Glacier Point 8000 ft. and Lake Tahoe, 6000–9000 ft. (Wheeler).

Washington: Seattle (Wheeler).

Colorado: Creede, 8844 ft. (S. J. Hunter).

British Columbia: Vancouver (Wheeler).

This ant like *C. laevigatus*, descends to sea-level in Washington and western British Columbia, but further south it is subalpine. Huge colonies of it were found at Lake Tahoe nesting in old pine logs and stumps.

187. *Camponotus herculeanus* subsp. *ligniperda* Latr. var. *noveboracensis* Fitch.

British Columbia: Agassiz (C. G. Hewitt).

Common east of the Rocky Mts. It is recorded also from Colorado, Washington, and Oregon.

188. *Camponotus schaefferi* Wheeler.

Known only from the Huachuca Mts., Arizona, where it was taken at altitudes of about 5000 ft. by C. R. Biedermann.

189. *Camponotus texanus* Wheeler.

From low elevations in Central Texas (Travis Co.).

190. *Camponotus sayi* Emery.

Arizona: Graham Mts. (E. G. Holt).

Known also from Phoenix and Prescott in the same state.

191. *Camponotus hyatti* Emery.

California: Palo Alto (W. M. Mann).

Originally taken at San Jacinto, Cala.

192. *Camponotus hyatti* var. *bakeri* Wheeler.

Catalina Island, Cala. (C. F. Baker).

193. *Camponotus fallax* Nyl. var. *nearcticus* Emery.
California: Angora Peak, Lake Tahoe, 7000 ft. (Wheeler).
Recorded also from Washington, Oregon, Idaho, California, and common throughout the Central and Eastern States.

194. *Camponotus fallax* var. *minutus* Emery.
I have referred some specimens from Vancouver to this variety, which, like the preceding is common in the Central and Eastern States.

195. *Camponotus fallax* var. *decipiens* Emery.
Known only from Indiana, Kansas, Colorado and Utah.

196. *Camponotus fallax* subsp. *rasilis* Wheeler.
Ranges through Arizona, Texas and Louisiana to Florida.

197. *Camponotus fallax* subsp. *rasilis* var. *pavidus* Wheeler.
Having much the same distribution as the preceding.

198. *Camponotus fallax* subsp. *subbarbatus* Emery.
According to Emery this form has been taken at Los Angeles, Cala. It is recorded also from Virginia, New Jersey and Illinois.

199. *Camponotus fallax* subsp. *discolor* Buckley.
Very common in Texas and known to extend up the Mississippi Valley to Oklahoma, Missouri and Illinois.

200. *Camponotus fallax* subsp. *discolor* var. *clarithorax* Emery.
This variety was originally described from San Jacinto, and Los Angeles, Cala. I have seen specimens from San Diego, Whittier, Felton, Santa Cruz Mts. and Three Rivers and have taken it in the Santa Inez Mts., near Santa Barbara. It ranges eastward as far as Illinois and Pennsylvania.

201. *Camponotus anthrax* Wheeler.
Known only from the Santa Inez Mts., near Santa Barbara, Cala., where I found it nesting under stones at an altitude of about 1000 ft.

202. *Camponotus* (*Myrmoturba*) *maculatus* Fabr. subsp. *vicinus* Mayr.
Arizona: Grand View, Grand Canyon (Wheeler).
California: Tenaya Canyon, Yosemite, 5000 ft. and Lake Tahoe (Tallac, Glen Alpine Springs and moraine east of Angora Peak),

6000–7000 ft. (Wheeler); Alpine (J. C. Bradley); San Gabriel Mts. near Claremont and Point Loma, near San Diego (Wheeler).

Previously known from several localities in California, Nevada, Oregon, Washington, Idaho, New Mexico and British Columbia.

203. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *plorabilis* Wheeler.

Recorded from California, Nevada and Idaho.

204. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *luteangulus* Wheeler.

British Columbia: Vancouver Island (Pergande Coll.), Dog Lake, Penticton (C. G. Hewitt).

Montana: Flathead Lake (C. C. Adams).

Arizona: Palmer's Canyon, Huachuca Mts. (Wheeler).

This variety is widely distributed as it is known also from other localities in Arizona, from Washington and Idaho. It seems, however, to be rare and sporadic.

205. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *semitestaceus* Emery.

California: San Jacinto Mts. (Fordyce Grinnell); Claremont (Metz); Friant (R. V. Chamberlin); Ramona (J. C. Bradley).

In Emery's "Beiträge," p. 672 this ant was originally described from "Plummer County, Cala., 5000 ft." but no such county exists. Examination of cotypes in the Pergande Collection recently acquired by the National Museum, shows that the specimens came from Plumas County.

206. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *nitidiventris* Emery.

Colorado: Chimney Gulch, Golden and Bear Creek, Morrison (E. J. Oslar); Golden (E. Bethel).

Arizona: Grand Canyon (Wheeler).

Recorded also from many other localities in Colorado, Wyoming, New Mexico and Northern California.

207. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *maritimus* Wheeler.

California: Santa Cruz Island (R. V. Chamberlin); Santa Cruz Mts. and Santa Inez Mts. near Santa Barbara (Wheeler).

This form occurs also on Catalina Island and along the coast at Pacific Grove, Cala.

208. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *infernalis* Wheeler.

California: Tenaya Canyon and Camp Curry, Yosemite 4000–5000 ft. and Lake Tahoe, 6000–7000 ft. (Wheeler); Wilson Peak, San Bernardino Mts., 7500 ft. (Fordyce Grinnell).

Arizona: Williams (Wheeler).

This variety occurs also in New Mexico where I have taken it at Las Vegas. Forel has recently redescribed it (from a single worker minor!) from Lake Tahoe as var. *subrostrata* (Deutsch. Ent. Zeitschr. 1914, p. 620).

209. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *dumetorum* Wheeler.

California: Berkeley (Wheeler).

This is a common form in the chaparral of the San Gabriel and Santa Inez Mts. of Southern California up to an altitude of 2000 ft. Forel has recently redescribed it (from a single worker media!) under the name of *C. maculatus maccooki* var. *berkeleyensis* from Berkeley, Cala. (Deutsch. Ent. Zeitschr. 1914, p. 619).

210. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *maccooki* Forel.

California: Palo Alto (W. M. Mann); San Ysidro and Carpinteria, near Santa Barbara and Tenaya Canyon, Yosemite 5000 ft. (Wheeler).

Previously recorded from other localities in California, Washington and Oregon. It is confined to the Pacific Coast and western slopes of the Sierra-Cascade Range. I failed to find it about Lake Tahoe.

211. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *sansabeanus* Buckley.

Arizona: Miller Canyon, Huachuca Mts. (Wheeler).

Previously recorded from Texas (as far east as Austin), New Mexico, Arizona and Colorado.

212 *Camponotus* (*Myrmoturba*) *maculatus* subsp. *sansabeanus* var. *torrefactus* Wheeler.

Originally described from the Grand Canyon, Arizona, 7000 ft. and East Mill Creek, Salt Lake Co., Utah.

213. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *bulimosus* Wheeler.

Known only from the canyons of the Huachuca Mts., Ariz. 5000–

6000 ft., where it was repeatedly taken by Dr. W. M. Mann, Mr. C. R. Biedermann and myself.

214. *Camponotus* (*Myrmoturba*) *fumidus* Roger var. *festinatus* Buckley.

Recorded from several localities in Texas, west of Austin and San Antonio, and from Arizona and Mexico as far south as Cuernavaca.

215. *Camponotus* (*Myrmoturba*) *fumidus* var. *fragilis* Pergande.

Taken by Dr. G. Eisen at San Jose del Cabo and San Fernando, Lower California.

216. *Camponotus* (*Myrmoturba*) *fumidus* var. *spurcus* Wheeler.

Described from Western Texas and the Huachuca Mts. Ariz.

217. *Camponotus* (*Myrmoturba*) *vafer* Wheeler.

Known only from the Huachuca Mts., Ariz.

218. *Camponotus* (*Myrmoturba*) *acutirostris* Wheeler.

Originally described from Alamogordo in the foot-hills of the Sacramento Mts., New Mexico (G. v. Krockow) and Box Canyon in the same region (A. G. Ruthven).

219. *Camponotus* (*Myrmoturba*) *acutirostris* var. *clarigaster* Wheeler.

Known only from the Grand Canyon, Ariz., 3000 ft.

220. *Camponotus* (*Myrmoturba*) *ocreatus* Emery.

Emery described this ant as a subspecies of *maculatus* from the Panamint Mts., Cala. Not having seen worker specimens I long suspected that it might prove to be identical with my *acutirostris* from Arizona. Recently I found a fine series of cotypes of *ocreatus* in the Pergande Collection (U. S. Nat. Mus.) and these show that the form is not only distinct from the typical *acutirostris* but that it is an independent species. The worker major of *ocreatus* has a much broader head, the clypeus is broader than long and its median lobe, though somewhat acute, is much shorter, less projecting and less angular than in *acutirostris*. The frontal carinae of the latter are much more lyriform and the color is different. In *ocreatus* the whole head, including the mandibles, clypeus, scapes and first funicular joint, is black, as are also the tibiae, the tips of the femora and the dorsal surface of the pronotum and anterior portion of the mesonotum. The cheeks lack erect hairs and foveolae. My subsp. *primipilaris*, however, evidently belongs to *ocreatus* and not to *acutirostris*. It is larger than the typical *ocreatus*, has much the same coloring of the legs and thorax and a similar clypeus, but the gaster is darker, the mandibles and clypeus are largely red and only the base of the first funicular joint is black. The Pergande Collection also contains specimens of the typical *ocreatus* labeled "St. Francis Mts., Mexico."

221. *Camponotus* (*Myrmoturba*) *ocreatus* subsp. *primipilaris* Wheeler.

Known only from Nogales and the Huachuca Mts. of Arizona, 5000–6000 ft. It has been repeatedly taken in the latter locality by Dr. W. M. Mann, Mr. C. R. Biedermann and myself.

222. *Camponotus* (*Myrmamblys*) *bruesi* Wheeler.

From Fort Davis, Texas, Chihuahua and Guadalajara, Mexico.

223. *Camponotus* (*Myrmobrachys*) *mina* Forel.

Known only from Cape St. Lucas at the tip of Lower California.

224. *Camponotus* (*Myrmobrachys*) *mina* subsp. *zuni* Wheeler.

Taken at Tucson, Arizona.

225. *Camponotus* (*Colobopsis*) *ulcerosus* Wheeler.

Known only from the canyons of the Huachuca Mts., Arizona, (5500–6000 ft.).

226. *Camponotus* (*Colobopsis*) *yogi* Wheeler.

Taken by Mr. Percy Leonard on Point Loma, near San Diego, California, nesting in twigs of manzanita.

227. *Camponotus* (*Colobopsis*) *abditus* For. var. *etiolatus* Wheeler.

Known from various localities in Western and Central Texas where it nests in pecan twigs and live oak galls.

228. *Camponotus* (*Colobopsis*) *pylartes* Wheeler.

Texas and Louisiana, nesting in twigs.

229. *Camponotus* (*Colobopsis*) *pylartes* var. *hunteri* Wheeler.

A pretty color variety of the preceding taken at Victoria, Texas, in twigs of pecan trees. This and the preceding form belong more properly to the Louisianian fauna.

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The ANCESTRY of INSECTS with PARTICULAR REFERENCES to CHILOPODS and TRILOBITES.

By John D. Tothill.

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ART. XXXVIII.—*The Ancestry of Insects with particular references to Chilopods and Trilobites*; by JOHN D. TOTHILL.*

Introduction.

DATING practically from the publication of Darwin's "Origin of Species," a fund of energy has been directed toward elucidating the probable descent of the various groups of living organisms. In these various groups different hypotheses of derivation have sometimes followed one another in rapid succession. Each in its turn has been of value as a working hypothesis and has often served to elicit new facts that have formed the basis of a supplanting hypothesis.

In the case of the Hexapoda the usual gamut of systems of classification and of genealogy—the one a necessary handmaiden of the other—has been proposed. We owe to the Greek civilization in general and to Aristotle in particular the first attempt to arrange insects in a system of related groups. In the interim between this first attempt (about 300 B. C.) and the more recent one of Handlirsch (1908) there have been many derivations proposed. Of these it is necessary simply to mention one or two of the more interesting. In 1866 Haeckel proposed a genealogical tree deriving the Insecta through the "Tocoptera" which included the "Thysanura," from "Tracheata" which also gave rise to the Arachnids and Myriopods. Three years later Brauer suggested a derivation through the Apterygogenea or wingless insects including Campodea and Thysanura; Brauer's system of classification was based on morphology, metamorphosis, and later on embryology; it was thorough-going and forms the basis of all subsequent systems;

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* Contribution from the Bussey Institution No. 119.

in 1885 it was revised and amplified into a form that has been in general use ever since. Packard in 1863 and 1870 suggested a derivation through the Apterygogenea (Lepisma) from the Myriopods.

Kingsley in 1894 emphasized the close relationship between insects and Chilopods and also the unnaturalness of the old group "Tracheata." In 1903 Carpenter reviewed the whole situation and came to the conclusion that Insects, Chilopods and Diplopods were probably derived independently from Symphyloid stock—a position that in the light of recent data is open to several serious objections.

Each of the various systems proposed has resulted from discoveries in morphology, development, or in paleontology. In recent years discoveries have been made in two directions, each throwing light on the problem of insect genesis. Through the efforts of Barrande, Walcott, Lindström, Beecher, and Raymond, our knowledge of detailed structures and of development in the interesting extinct group Trilobita has been greatly extended. On the other hand, Handlirsch following the trail blazed by Brongniart and Scudder has greatly enriched our knowledge of insect paleontology. In his remarkable book "Die Fossilen Insekten" there is proposed a new system of classification based, as was Brauer's, on development, morphology, and particularly on paleontology. There is also proposed a heterodox ancestry in which the Hexapods are derived not in the usual way through the Apterygogenea from terrestrial tracheate myriopod-like animals but directly from trilobites. This derivation is accepted without reserve by Schuchert (1915) in his exceedingly illuminating Text Book of Geology, and it has also been accepted by Ruedemann (1916). While it is suggestive and very helpful it is open to certain objections and the time seems, therefore, opportune to once more review the whole question of insect genesis. The object of the paper will be largely achieved if it succeeds only in stimulating the search for further facts.

An examination of the available data.

In tracing the lineage of any complex of related organisms the first point is of course to discover the most generalized members of the group. In the insects these have been sought in both the wingless Apterygogenea and in the winged Pterygogenea. In the case of the former it will serve the present purpose to recall some of the salient features in a few characteristic examples. In *Lepisma saccharina* (fig. 1, A and B), the mouthparts are greatly specialized by reduction, the eyes are also reduced; on the other hand the primitive number of abdominal segments, namely, 11, is retained, the tritocerebral appendage shows as a rudiment in the young embryo (Heymons, '97), and there are 11 pairs of spiracles whereas in the winged insects these are reduced to ten. In *Anurida maritima* (fig. 1, C and D) studied especially by Claypole ('98) the mouthparts show considerable reduction as also do the eyes; of particular interest is the reduction of abdominal segments; also according to the same author this singular animal shows no traces whatever of a tracheal system; on the other hand the first pair of abdominal appendages is preserved as the collophore (Claypole, Wheeler) and the same authors agree that the tritocerebral appendage is preserved (fig. 1, C). In *Sminthurus* (fig. 1, E) and *Anurophorus* (fig. 1, F) there is specialization by reduction of mouthparts, eyes and abdominal segments; on the other hand several pairs of abdominal appendages are preserved even in the adult condition.

FIG. 1.

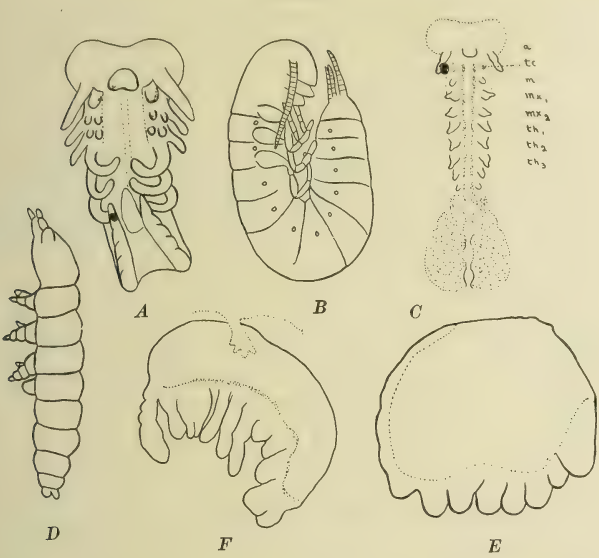

FIG. 1.

A. Lepisma saccharina, young embryo. (After Heymons.)

B. " " mature embryo. (After Heymons.)

C. Anurida maritima. Very young embryo showing the tritocerebral appendage *tc.* (After Wheeler.)

D. Anurida maritima, adult showing collophore, reduced mouth parts, and reduction of abdominal segments. (After Claypole.)

E. Sminthurus. Young embryo showing reduction of abdominal segments. (After Lemoine.)

F. Anurophorus. Embryo showing reduction of abdominal segments. (After Lemoine.)

Examples could be multiplied but sufficient has been said to indicate that the Apterygogenea occasionally preserve even in the adult condition primitive 'ancestral' characters, such as the tritocerebral and abdominal appendages, structures that have almost or completely disappeared in the Pterygogenea. In this sense they are more generalized than any other living insects. Enough has also been said to indicate on the other hand that the Apterygogenea are highly specialized animals as indicated by the frequent reduction of mouthparts, visual organs, tracheæ, etc.; and by the development of peculiar structures such as the caudal "spring" and the collophore. Handlirsch points out that the absence of wings does not necessarily represent a primitive condition, but that these insects may have once possessed wings and lost them as a result of taking up their abode in the peculiar environment in which they now live. In cave insects, such as ants, and in parasitic insects (especially of fur- or hair-bearing vertebrates), such as the fleas and lice, reduction or loss of wings is extremely common. Be this as it may, the various specializations found in the group seem to make it certain that it is not in the direct line of descent of the great Pterygogenea complex.

Turning to the Pterygogenea, the remarkable findings of Handlirsch from the Pennsylvanian rocks engendered a new point of view concerning the most generalized insect. *Stenodictya* (fig. 2) is typical of these ancient insects and I will confine my remarks to it. It is a large insect with well-differentiated head, thorax and abdomen; with all abdominal segments and with well-developed cerci. The wings are of peculiar interest in that the venation is practically that of the "hypothetical wing" long since suggested by Comstock and Needham. The organs of flight are also of interest in that a small pair is developed on the prothorax and because all the abdominal segments show lateral wing-like outpushings. This seems to indicate the method of origin of wings and does away with the necessity of deriving the winged insects from the Apterygogenea.

In a word the Palæodictyoptera as illustrated by *Stenodictya* appear to represent the ancient stock from which the present Pterygogenea complex has been derived.

If this inference is correct then the problem resolves itself into discovering an ancestor for the Palæodictyoptera. Before developing the problem, however, it may be pointed out that the abdominal appendages on the *Stenodictya* larva (fig. 2, B) figured seductively by Handlirsch opposite a figure of a trilobite with the same sort of appendages are of doubtful phylogenetic significance. The insect was aquatic in its early stages and yet most of the Pennsylvanian insects were terrestrial. In recent aquatic insects such as *Sialis* and *Sisyra* there are serially arranged jointed appendages functioning as gills, but all such structures in recent insects are shown by embryology to be secondarily acquired. It seems fairly certain that the similar structures in *Stenodictya* are secondarily derived and that insects were originally terrestrial; in this case the structures would have no phylogenetic significance.

Returning to our problem, it may be of interest to construct from the available data a hypothetical ancestor for the Pterygogenea. As wings seem to have arisen in the Palæodictyoptera the ancestor would have no wings and consequently the thoracic segments would be no larger than the abdominal. The result would be an animal with head and trunk, the latter with 14 segments (fig. 3). The habit must have been predaceous which would imply a short straight alimentary tract.

Fig. 2.

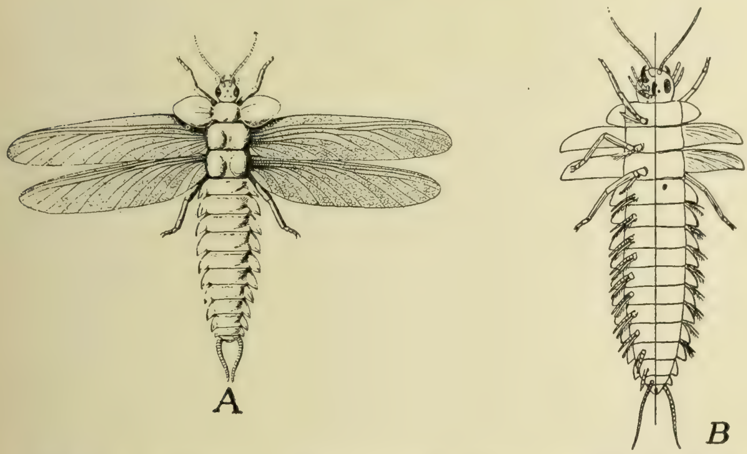

Fig. 2. A. *Stenodictya* (Palæodictyoptera), one of the most generalized of all Pterygogenea. (After Handlirsch.)
B. Larva of *Stenodictya*. The abdominal appendages are probably secondary. (After Handlirsch.)

Turning to the structure of the nervous system, one of the most conservative of morphological structures and consequently one of the most useful for phylogenetic purposes, embryology of recent forms (Viallanes, Wheeler) shows that there are six neuromers in the head, a brain triad and a gnathal triad, and that a pair of ganglia connected by commissures follow in each segment. Cephalization would be less marked than in recent insects. The nervous system is indicated in the diagram (fig. 3, B).

In insect embryos one of the most universal and striking features is the early development and final disappearance of paired appendages on the abdominal segments. Graber, Wheeler, Heymons and others have figured these structures in numerous insects; I find they occur also in *Paratenodera* (fig. 4), *Chauliodes*, *Ranatra* and *Polistes*. The only possible interpretation seems to be that these rudiments represent a condition of serial polypody in ancestral forms. This condition is therefore represented in the diagram.

Fig. 3.

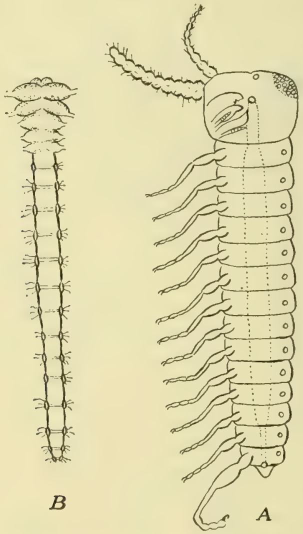

Fig. 3. Generalized hypothetical ancestor of Pterygogenea. (Original.)

In figure 4 it can be seen that the tracheæ have already invaginated—i. e. the spiracles are plainly visible. These invaginations occur generally in insects at an extremely early stage, in fact immediately after the appearance of the appendages. This seems to indicate that they are ancient structures and that the immediate wingless forbears of insects were tracheate and therefore terrestrial. The hypothetical ancestor may, therefore, be supplied with tracheal invaginations—at least ten pairs as in insects, and probably fourteen.

There remains the head. I cannot discuss the question of head segmentation at this time, interesting though it is. Viallanes, Wheeler and Heymons are agreed that the insect head is composed of six segments and these investigators have paid particular attention to the development of the brain. Folsom

(1900), working with the tiny embryo of *Anurida*, supposes there are seven segments; the presence of the extra pair of appendages described has not been verified, and seems to be extremely doubtful. Janet (1899), arguing from adult anatomy, supposes there are seven segments; the evidence is not at all convincing. In the diagram I have, therefore, indicated six head segments.

The rudiments of the maxillæ in insects are characteristically paired on each side and possibly indicate a biramous condition of all the ancestral appendages. The evidence, however, only points directly to the biramous condition of the first and second maxillæ.

Fig. 4.

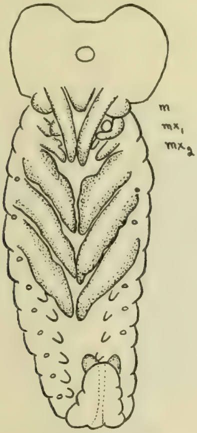

Fig. 4. Germ band of *Paratenodera sinensis*, a Chinese mantid, showing the rudiments of abdominal appendages, and the spiracles. (Original.)

The hypothetical ancestor being now visualized (fig. 3), the next problem is to search for such an animal in the various kindred groups of which we have knowledge.

The Arachnoidea are by general consent considered to be specialized in their own particular direction and may be passed by in silence.

One of the most interesting of all groups is that of the Trilobites. In early Cambrian times they were already greatly differentiated and dominated the life of the oceans, thus occupying the ecological position that the fish do to-day. Some were very small, some more than a foot long; some lived in deep waters, some in shallow; some were bottom feeders and others pelagic. In Ordovician times the group reached its climax both in the number of species and in diversity of form.

With the differentiation and multiplication of fish in the Silurian epoch there was initiated the beginning of the end of trilobites and the number of species fell away rapidly. There was a slight expansion in the Devonian and as in the preceding age there was a marked tendency toward the development of (to us) curiously bizarre and ornamented forms. There followed a rapid decline and the group became extinct with the passing of Paleozoic time. More than 2000 species have been described and this can represent but a fraction of the total.

FIG. 5.

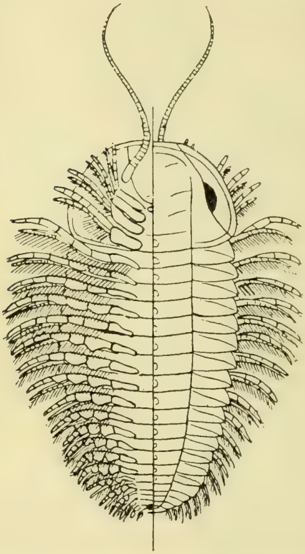

FIG. 5. The trilobite *Triarthrus beckii.* (From Handlirsch after Beecher.)

It is a source of surprise that a group showing such collective vitality should have given rise to no terrestrial forms as have the Annelida, Malacostraca, Arachnoidea, Gastropoda, and Vertebrata. Handlirsch indeed takes exception to this view and derives a number of groups directly or indirectly from these ancient crustaceans. As insects are numbered among these the similarities may be examined somewhat closely.

In *Triarthrus beckii* (fig. 5), studied with such signal success by Beecher, there are two regions, head and trunk. On the twenty or so trunk segments are serially homologous biramous jointed appendages. The head carries five pairs of appendages, thus indicating *at least* five segments.

The trilobite head problem here suggests itself. Beecher

('96) supposes that the head of *Triarthrus* is made up of at least six segments and possibly of seven; Jaeckel ('01) finds at least six head segments in a series of trilobites and supposes a total of eight. These findings cannot be taken too seriously for the reason that the developing trilobite brain has not been examined—and it is in the ontogeny of the head that the key to the same problem in other groups (Arachnida, Hexapoda, Vertebrata) has been found. They are, however, highly suggestive and it is probable that trilobites had at least as many head segments as insects, perhaps the same number.

Returning to *Triarthrus*, the long antennæ are instructive as are also the compound eyes.

Fig. 6.

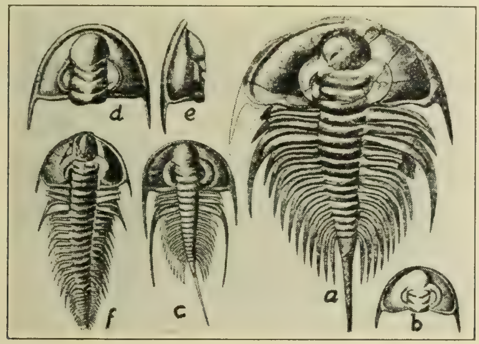

Fig. 6. *a, b, Olenellus thompsoni; c–e, O. gilberti; f, Mesonacis vermontana.* Showing specialization of first three post-cephalic segments. (From Grabau and Shimer, after Walcott.)

Lindström (1901) among others has paid special attention to the eyes of trilobites and finds at least three kinds—isolated eyes or ocelli, aggregate eyes of biconvex lenses, and compound eyes. The three kinds of insect eyes are roughly comparable and it is conceivable that they may have been derived from those of trilobites.

In *Olenellus* (fig. 6) there is a regional specialization of the first three post-cephalic segments. In many trilobites, such as *Albertella*, *Ceraurus*, there is a tendency toward specialization of the caudal extremity by the formation of caudal spines; in *Neolenus serratus*, whose appendages have been recently discovered by Walcott on specimens from the Burgess shale (Middle Cambrian), there are jointed caudal rami strongly suggestive of insect cerci.

In some respects, therefore, the trilobites, especially such generalized forms as *Mesonacis* (fig. 6) and *Paradoxides*, fulfill the requirements of our hypothetical insect ancestor. The absence of spiracles and the general lack of strong convincing evidence of close relationship indicates, however, that if a relationship exists, as seems quite likely, it is scarcely as close as supposed by Handlirsch. I will return to the group later.

Fig. 7.

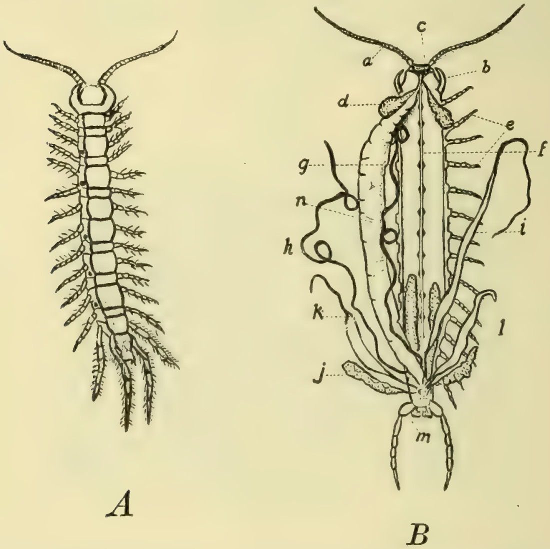

Fig. 7. A. *Lithobius* adult. A representative chilopod. (After Koch.) B, *Lithobius* ; *a*, Antennæ ; *b*, Maxillipedes ; *c*, Brain ; *d*, Salivary glands ; *e*, Legs ; *f*, Ventral nervous system ; *g* and *h*, Malpighian tubes ; *i*, Vesicula seminalis ; *j* and *k*, Accessory glands. (After Vogt and Yung.)

The Progoneata, characterized by the Diplopoda, are by general agreement of myriapod students less closely related to the Opisthogoneata (Chilopoda) than they are to insects. They throw little or no light upon the present discussion.

Turning to the Chilopoda, there are no fossil forms yet known that throw much light upon their lineage, even *Palæocampa* is distinctly disappointing. Recent forms are, however, plentiful and illuminating. A dissection of *Scolopendra* shows that the nervous system is almost identical with that in generalized insects. In *Lithobius* (fig. 7, A and B) the number of trunk segments is reduced to 16 (compare fig. 3); a tracheal system histologically identical with that of insects is well developed ; also the last pair of legs is larger than the others and suggest the insect cerci. The problem of head segmentation has been studied by Heymons for *Scolopendra* and the head is composed of six segments as in insects. I find the same condition in *Scolopendra*, *Linotænia* and *Cryptops*. In all these forms the mandibles and two pairs of maxillæ correspond to those in the Pterygogenea and the maxillæ are biramous. The whole group exhibits the condition of serial polypody so characteristic in insect embryos. Several kinds of eyes are also found in the group (although reduced by reason of cave habits) and from these it would seem an easy transition to the eyes of insects. Embryological development is also remarkably similar in the two groups but that of Chilopods is in several important respects less specialized.

In short the Chilopods are unquestionably very intimately related to the Pterygogenea, as Kingsley, Korscheldt and Heider, Heymons and others have pointed out. An ancient Chilopod showing no specialization of the maxilliped would have looked suspiciously like fig. 3 and would have fulfilled the specifications better and more closely than any trilobite known at the present time.

The Ancestry of the Opisthogoneata.

If, as seems probable, the Pterygogenea arose from an ancient Chilopod stock it may be interesting to speculate concerning the ancestry of Chilopods. The primitively biramous condition of appendages is suggested by the embryonic condition of the two pairs of maxillæ and of the maxillipedes, also by the slight thickenings at the base of all the embryonic trunk appendages in *Scolopendra*, *Cryptops* and *Linotænia*. The spiracles develop early but perhaps not quite as early as in insects—the point needs reinvestigation. In embryos of the same forms also, as pointed out by Heymons for *Scolopendra*, there are rudiments of two pairs of antennæ.

The extremely interesting and anomalous *Onychophora* invite at least inspection in this connection. Many investigators have supposed that this group, represented by the single genus *Peripatus*, is related to the tracheate arthropods because of the paired appendages and tracheæ. As Handlirsch points out, however, the tracheæ are in position and histological structure utterly unlike those of Chilopods and Hexapods. It may be recalled that tracheæ also occur in many terrestrial Arachnoidea and in some half dozen or so genera of Isopod crustaceans. In these latter cases the tracheæ have clearly arisen independently and there seems good reason for supposing an independent derivation in the case of *Peripatus*. The peculiar fleshy legs and the nervous system are also very unlike the corresponding structures in Chilopods or insects. It seems therefore less of a mental effort to regard these animals as an independent offshoot from Polychæte annelids than to regard them as a direct bridge between Annelids and Chilopods.

Returning to the Trilobites, practically all that was said concerning the similarities between generalized trilobites and Pterygogenea would apply with even greater force to Chilopods. Regional divisions of head and trunk, polypody, head segmentation, antennæ, eyes and cerci all suggest affinities.

If in Cambrian times an adventurous species of the Mesonacidæ had left its marine surroundings to discover the terrestrial world, it seems a fair guess that gills would have been exchanged for lungs or tracheæ. With no further change than the loss of gills and acquisition of tracheæ (a change actually accomplished in the Isopoda and certain Arachnoidea) our bold adventurer would now resemble in many fundamental respects a generalized Chilopod.

The lack of knowledge concerning the trilobite head and the all-important nervous system preclude the possibility of attaching more than suggestive value to a trilobite derivation of the Chilopods. With the present lack of data, however, this derivation seems at least as logical as any of the various ones suggested.

Conclusion.

In conclusion a survey of the available data shows that the Pterygogenea are closely related to Chilopods and were quite possibly derived from an ancient stock in which the maxillipedes were not developed as jaws. Also that the Chilopods were in turn very likely, though by no means certainly, derived as Handlirsch suggests, from ancient generalized trilobites.

The probability of this derivation is increased by comparing the manner of development in each group. In the trilobites Barrande, Beecher, and others have shown that practically all the segments were added after the egg stage; in the Chilopods, Zograv, Voerhoff, and Heymons have shown that most of the specialization by addition of segments takes place during the egg stage; in the Hexapods numerous investigations have shown the segments arise only during the egg stage. This brief series exemplifies one of the most fundamental changes that has been undergone in the entire history of animals.

From the ethological point of view also this series represents a transition from predaceous marine animals, to predaceous terrestrial wingless forms, to predaceous terrestrial winged animals.

From the point of view of vertical distribution a glance at figure 8 shows the possibility of the derivations suggested. Trilobites were well differentiated at the base of the Cambrian series and reached their maximum deployment in Ordovician waters; they disappeared toward the end of Paleozoic time. The Chilopoda are known from Pennsylvanian rocks through the discovery of *Palæocampa*. As this is clearly a highly specialized form (in virtue of the elaborate system of macrochætæ and the small number of segments) it seems probable that the group was highly differentiated in Pennsylvanian times and that it arose in much earlier Paleozoic times. Many insects are known from the Pennsylvanian rocks; it seems

Fig. 8.

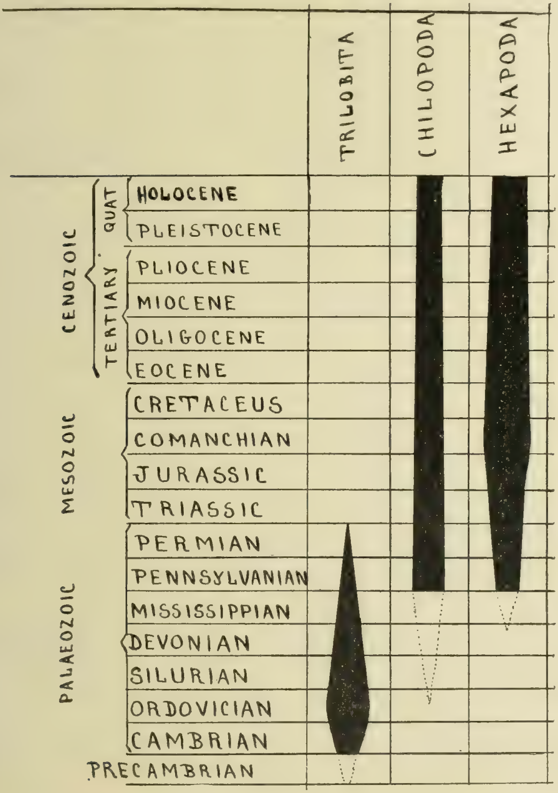

Fig. 8. Vertical distribution of trilobites, centipedes and insects. (Original.)

clear that they reached their stage of maximum deployment in the Mesozoic era and that they are now in a condition of decline.

I wish finally to express my appreciation of the kindly help and criticism given during the preparation of this paper by Dr. Percy E. Raymond in the field of paleontology; by Dr. R. V. Chamberlain in connection with Chilopod structures and embryology; and by Dr. Wm. M. Wheeler in the field of insect embryology.

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With the compliments of the Author.

THE AUSTRALIAN ANT-GENUS MYRMECORHYNCHUS (ERN. ANDRÉ) AND ITS POSITION IN THE SUBFAMILY CAMPONOTINAE.(1)

By WILLIAM MORTON WHEELER.

(Communicated by Arthur M. Lea.)

[*From "Transactions of the Royal Society of South Australia," vol. xli., 1917.*]

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[Read November 9, 1916.]

PLATE I.

Twenty years ago the late Ernest André founded the genus *Myrmecorhynchus* for the reception of a singular Camponotine ant, *M. emeryi*, which he described from a unique worker, measuring 3 mm., taken in the Alps of Victoria.(2) Two years later Emery(3) received a specimen of the same ant from Mr. Tepper, of the Museum of South Australia, and as it was larger than André's specimen (4·5 mm.) and had a broader head and traces of ocelli, he naturally concluded that it was the major worker of the species of which André's specimen represented the minor. During December, 1914, I found under a large stone on a roadside at Enoggera, near Brisbane, Queensland, what I now know to have been a small colony of *Myrmecorhynchus*. It comprised only a few workers, all of the same size as those reported by André and Emery. Unfortunately I have not succeeded, since my return to the United States, in finding the few specimens which I secured. They were evidently mixed with and lost among a great many specimens of *Iridomyrmex*, *Melophorus*, and other genera bottled on what proved to be a very hasty excursion. The authorities of the Museum of South Australia, however, have recently sent me a series of workers and larvae from a *Myrmecorhynchus* colony discovered by Mr. H. B. White at Windsor, South Australia. These workers are of three different types, ranging from 2·5 to 6·5 mm. The smallest, corresponding with André's type specimen, is, therefore, the worker minima, those measuring 4-4·5 mm. are mediae, and correspond with Emery's specimen; while the maxima, hitherto unknown, has a much larger and broader head, with more distinct ocelli. It seems advisable, therefore, to describe and figure the different forms and to rewrite the generic and specific diagnoses, in order that Australian entomologists may more easily recognize this rare and evidently archaic ant, secure additional specimens, especially of the unknown male and female, and investigate its habits.

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(1) Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 120.

(2) Fourmis Nouvelles d'Asie et d'Australie, Rev. d'Ent. 15, 1896, pp. 253 and 254.

(3) Descrizioni di Formiche nuove malesi e australasiane; note Sinonimiche. Rend. Accad. Sc., Bologna, N.S. 2, 1898, p. 237, figs. 9 and 10.

Genus MYRMECORHYNCHUS, Ern. André.

Worker. Polymorphic, presenting distinct maxima, media, and minima forms, differing especially in the size and shape of the head. Worker maxima with the head large and broad, with large elliptical, feebly-convex eyes, placed near the middle of its sides but on the dorsal surface. Mandibles triangular, very convex, with numerous, rather crowded, acute teeth on the apical border. Palpi short; maxillary pair 6-jointed, labial pair 4-jointed. Clypeus large, trapezoidal, not extending back between the antennal insertions or frontal carinae, with an anterior projecting, median lobe. Frontal area large, distinct, triangular. Frontal carinae short, narrow, diverging behind, not concealing the insertions of the antennae, which are very near the posterior clypeal border and the anterior ends of the frontal carinae. Frontal groove distinct. Ocelli small, but well developed. Clypeal and antennal foveae confluent. Antennae 12-jointed. Funiculi gradually enlarged towards the tip, with the five terminal joints forming an indistinct club. In the minima the head is much narrower, the eyes more prominent and proportionally larger and situated more on the sides of the head, the clypeal lobe is much more projecting, the mandibles much more elongate with straight lateral borders, less convex dorsal surfaces, and more numerous teeth. The ocelli and frontal groove are absent, the antennae more slender. The media is intermediate in the shape of the head between the maxima and minima, the frontal groove is feeble, and the ocelli are minute or indicated by pits. All three forms have the thorax, petiole, and gaster of essentially the same shape. Thorax rather small and narrow, scarcely longer than the head, including the mandibles, with deep and rather long meso-ëpinotal constriction, with distinct promesonotal suture and the mesonotum bounded behind by a distinct suture separated by a space from the anterior suture of the epinotum. In this space, representing the metanotum, lie the metathoracic spiracles, which are produced and distinctly tubular, especially in the media. Epinotum rounded and unarmed. Petiole with well-developed, erect, bluntly rounded scale. Gaster voluminous, its first segment smaller than the second and third, which are subequal; the constrictions between the segments well marked. Anal orifice surrounded by a circlet of cilia. Middle and hind tibiae with short but distinct spurs; tarsi with well-developed, rather straight, simple claws. Proventriculus (fig. 2) small and very short, the bulb scarcely longer than broad, feebly chitinized, the sepals of the calyx more heavily chitinized, extremely short, turned outwards but not reflected.

MYRMECORHYNCHUS EMERYI, Ern. André.

Worker Maxima (fig. 1, *a* and *b*). Length, 6-6·5 mm.

Head convex above, excluding the mandibles a little broader than long, broader behind than in front, with straight posterior border and feebly convex sides. Mandibles one-third as long as the head, with convex outer borders and dorsal surface, their inner borders with 8-9 acute teeth, gradually decreasing in length towards the base. Clypeus convex, strongly carinate, its anterior border produced in the middle as a distinct lobe, narrowly emarginate in the middle and rather deeply sinuate on each side. Its posterior border is straight and transverse in the middle. Frontal carinae terminating behind opposite the middle of the eyes. Antennal scapes curved, narrow and slightly flattened at the base, thickened gradually towards their apices, which scarcely reach to the posterior corners of the head. All the funicular joints longer than broad; first joint equal to the two succeeding joints together; joints 2-5 subequal, 1½ times as long as broad; remaining joints a little longer; terminal joint fully twice as long as broad, nearly as long as the two preceding joints together. Thorax through the mesonotum a little more than half as broad as the head, broadest through the pronotum, which is as long as broad including the rather long neck, rounded above and higher than the epinotum. Mesonotum transversely elliptical, convex, rounded, and sloping. Epinotum from above subrectangular, with parallel sides, longer than broad; in profile higher than long, with distinct and subequal base and declivity, the former horizontal, the latter sloping and feebly concave below. Petiolar scale from above transverse, twice as broad as long, in profile lower than the epinotum, thick, as thick above as below, with straight, flattened anterior and posterior surfaces and rounded summit; its ventral portion convex, laterally compressed. Gaster large, elliptical, convex above, its tip somewhat pointed. Legs rather slender. Shining. Mandibles covered with sparse, coarse punctures. Clypeus, head, and thorax subopaque, coarsely shagreened; sides of head more granular or densely and finely punctate; the clypeus and anterior portions of cheeks longitudinally rugose, the front divergently rugulose. Upper-surface of thorax transversely, the sides of pronotum, the mesopleurae and sides of epinotum vertically rugulose. Petiole and gaster very finely and superficially shagreened, shining, with small, sparse, piligerous punctures.

Hairs white, erect, moderately long, not very abundant, rather uniformly inverting the body, scapes, and legs. Pubescence absent. Chestnut-brown; upper-surface of head and epinotum darker; petiole above and gaster black; mandibles brownish-yellow, with black teeth; dorsal surfaces of scapes towards their tips blackish; legs with the middle portions of the femora and flexor surfaces of the tibiae dark-brown; extensor surfaces of the latter brownish-yellow.

Worker Media (fig. 1, *c*). Length, 4-4·5 mm.

Head smaller than that of the maxima, as long as broad, with straight sides and more convex, laterally situated eyes, the median lobe of the clypeus more projecting, the mandibles longer and less convex, with about the same number of teeth as the maxima, the antennal scapes longer, more slender, extending a little beyond the posterior corners of the head. In other respects like the maxima.

Worker Minima (fig. 1, *d*). Length, 2·5-3 mm.

Differing from the media in the shape of the head, which is decidedly longer than broad, rounded behind, and has very prominent eyes. The clypeus is longer, with longer anterior lobe, and the mandibles are much longer and narrower, with straight external borders and 10-11 teeth. The antennae are very slender, with the scapes extending considerably beyond the posterior border of the head. The head behind and the dorsal portion of the thorax are much less sharply sculptured than in the media and maxima, so that these regions are smoother and more shining. In other respects the sculpture, pilosity, and colour are much as in the media and maxima.

Young Larva (fig. 4, *a*, *b*, *c*). Body plump, with distinct segments, constricted behind the prothoracic segment, which is large and swollen. Head rather small, broad, and rounded, covered with sparse, simple hairs, without antennae and with short maxillae and labium furnished with the usual truncated sense-papillae. Mandibles small, flattened, falcate, with long apical tooth and blunt denticles along the inner border. Surface of body covered with flexuous, 2-, 3-, or 4-branched hairs, except the ventral thoracic surface, which is beset with simple, bristly hairs.

Adult Larva (fig. 4, *d*, *e*, *f*). Body much swollen, but with distinct segments. Head extremely small. Hairs almost lacking, except on the head and ventral surface of the anterior segments, where the hairs are short, simple, and bristly. The shape of this larva suggests that it does not spin a cocoon but forms a naked pupa.

Described from six maxima, seven media, and three minima workers and a dozen larvae taken from a single colony at Windsor, South Australia, by Mr. H. B. White.

The question of the position of *Myrmecorhynchus* among the various tribes and genera of the Camponotinae leads me to a consideration of Forel's most recent arrangement of this subfamily in the sixth part of his "Formicides Néotropiques."(4) He divides the Camponotinae into three sections —the Procamponotinae, the Mesocamponotinae, and the Eucamponotinae—on the structure of the proventriculus, or "gizzard." In the first section, which contains only one genus, the extraordinary Malayan *Myrmoteras*, the gizzard has a very short calyx, with widely diverging, heavily chitinized sepals, strongly recurved at their tips. The Mesocamponotinae have the calyx reflected and comprise three tribes—the Melophorini (genera *Notoncus* and *Melophorus)*, the Plagiolepidini (genera *Rhizomyrma*, *Plagiolepis*, *Acantholepis*, *Acropyga*, and the Myrmelachistini (genera *Myrmelachista*, *Aphomomyrmex*, *Brachymyrmex*, and the fossil *Rhopalomyrmex)*. The Eucamponotinae, which have the gizzard "straight or slightly curved, but never reflected," embrace five tribes—the Gesomyrmini (genera *Gesomyrmex* and *Dimorphomyrmex)*, the Prenolepidini (genus *Prenolepis)*, the Formicini (genera *Pseudolasius*, *Lasius*, *Formica*, *Polyergus*, *Myrmecocystus*, and *Cataglyphis)*, the *Oecophyllini* (genera *Gigantiops*, *Myrmecorhynchus*, and *Oecophylla)*, and the Camponotini (genera *Camponotus*, *Echinopla*, *Polyrhachis*, *Dendromyrmex*, *Calomyrmex*, and *Opisthopsis)*.

While considerable portions of this classification are undoubtedly well founded, there are at least two genera, *Myrmoteras* and *Myrmecorhynchus*, whose interpretation and position seems to me to be open to discussion. Forel believes that *Myrmoteras* is an extremely ancient and primitive type, a veritable "living fossil," which "shows that the Camponotinae must be directly derived from some primitive aberrant Ponerine like *Odontomachus*, *Stigmatomma*, or *Mystrium*." He inclines to this view because the worker and female *Myrmoteras* have a head remarkably like that of *Odontomachus*, with long, linear, toothed jaws, inserted close together. It seems to me that he has reached this peculiar conclusion through supposing that an ancient is necessarily a primitive and ancestral form. Undoubtedly *Myrmoteras* is a very old Mesozoic genus, but its two surviving species, *M. binghami*, Forel, and *M. donisthorpei*, Wheeler, are at the same time extremely specialized, as shown by the wing-venation and the structure of the head and legs. The resemblance to *Odontomachus* and similar Ponerine genera (which are themselves highly specialized and by no means ancestral forms) are due to convergent development, and indicate even less generic affinity to the Ponerinae as a subfamily than is exhibited by many Eucamponotine genera. It may, perhaps, be advisable to make a special Camponotine section for the accommodation of the genus *Myrmoteras*, but to name this section "Procamponotinae" is, to say the least, misleading.

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(4) Mém. Soc. Ent., Belg., 20, 1912, pp. 87 to 92.

André, from a study of his single minor worker, concluded that *Myrmecorhynchus* "bears a certain resemblance to the Oecophyllas, in the neighbourhood of which it should probably be placed." Forel seems to have accepted this position as established, since, as we have seen, he places the genus, together with *Gigantiops* and *Oecophylla* in the Oecophyllini, his fourth tribe of Eucamponotinae, characterized by having "the gizzard long and narrow, with straight calyx." Such a gizzard is, of course, found in *Oecophylla* and *Gigantiops*, as shown in fig. 3, but the gizzard calyx of *Myrmecorhynchus*, as I have endeavoured to show in fig. 2, is entirely different. There is, to be sure, as André maintained, a certain resemblance between *Myrmecorhynchus* and *Oecophylla* in the shape of the head, particularly of the mandibles and clypeus, and of the thorax; but this resemblance is apparent only in the worker minima of the former genus. *M. emeryi* is, moreover, terrestrial, whereas the species of *Oecophylla* and *Gigantiops* are arboreal. One who had first seen the large workers of *Myrmecorhynchus* would be inclined to place it near *Camponotus*, both on account of the shape and structure of the head and of the pronounced polymorphism of the worker. But the genera of the tribe Camponotini also have a gizzard with long, narrow, straight sepals, and the clypeal and antennary fossae are non-confluent. One meets with no better success in endeavouring to fit *Myrmecorhynchus* into other tribes in Forel's scheme. We are compelled, therefore, either to establish a new tribe, Myrmorhynchini, in the section of Eucamponotinae, for its reception, or to leave the position of the genus undecided till the male and female of its single species have been discovered and studied.

EXPLANATION OF PLATE I.

Fig. 1. *Myrmecorhynchus emeryi*, Ern. André. *a*, worker maxima, lateral view; *b*, head of same, dorsal view; *c*, head of worker media; *d*, head of worker minima.

Fig. 2. *Myrmecorhynchus emeryi*, Ern. André. Proventriculus from the side.

Fig. 3. *Oecophylla smaragdina*, Fabr. Proventriculus from the side.

Fig. 4. *Myrmecorhynchus emeryi*, Ern. André. *a*, young larva, lateral view; *b* and *c*, branched hairs of same; *d*, adult larva; *e*, head of same, dorsal view; *f*, mandible of same.

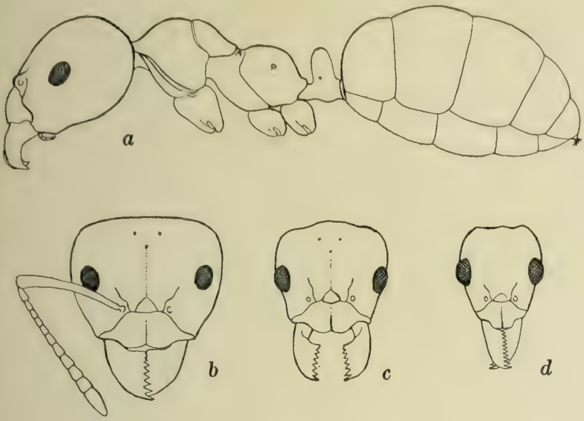

Fig. 1.

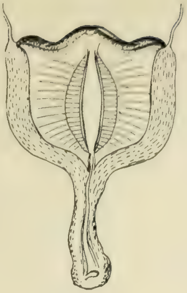

Fig. 2.

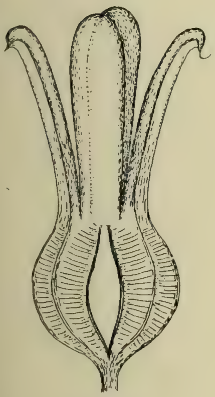

Fig. 3.

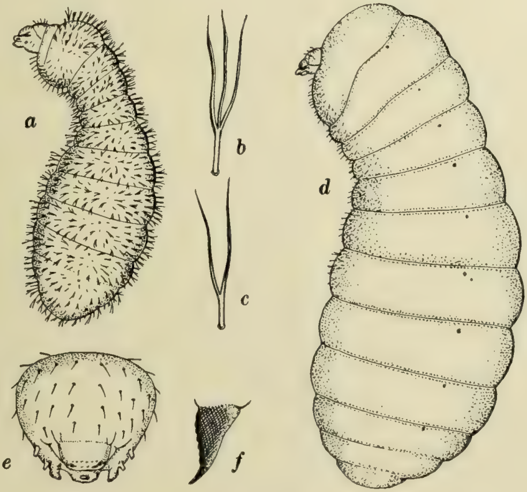

Fig. 4.

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[Reprinted from PSYCHE, Vol. XXIV, No. 1]

NOTES ON REARING INSECTS FOR EXPERIMENTAL PURPOSES AND LIFE-HISTORY WORK.[1]

By A. M. Wilcox,[2]
Gipsy Moth Assistant, U. S. Bureau of Entomology.

Introduction.

During the past two years I have been rearing insects for experimental and life-history studies. While engaged in this work it became necessary to develop new rearing methods and to modify some of the old ones.

The rearing of insects from egg to adult is not always an easy task. Unforeseen difficulties arise anew with every species, in consequence of which I am offering these notes with the hope that entomologists will find them serviceable.

During the life history of insects reared artificially, the following must be observed:

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[1] Contribution from the entomological laboratory of the Bussey Institution in coöperation with the U. S. Bureau of Entomology. (Bussey Institution, No. 121.)

[2] The writer desires to express his thanks to those who rendered valuable assistance in the preparation of this paper: Prof. William M. Wheeler, Dean of the Bussey Institution, Harvard University, and Mr. A. F. Burgess, in charge of gipsy-moth work, for their helpful criticisms; Dr. R. W. Glaser and Dr. J. W. Chapman of the Bureau of Entomology, for their suggestions; and Mr. Harold A. Preston of the same Bureau for the preparation of the illustrations.

1. Provision for an abundance of normal food.
2. Provision for a suitable larval environment.
3. Provision for a suitable pupal environment.
4. Provision for a suitable adult and egg laying environment.
5. Regulation of temperature and humidity.
6. Prevention of disease.
7. Prevention of parasitism by other insects.

THE USE OF FRUIT JARS WITH TIN COVERS.

The general use of shallow fruit jars (Pl. II, fig. 1) has been found extremely successful for many species of insects. By altering conditions slightly for each stage (egg, larval, pupal and adult), these jars can be used throughout the life of many forms. The jars are four inches deep and four inches in diameter. The tin tops can be screwed on tightly without the use of rubber bands. Insects confined in these jars cannot escape, nor can parasites enter.

It is easy to duplicate conditions required by insects fond of a moist environment or which pupate in the soil. If at any time an excess of moisture forms, it may be diminished by loosening the screw tops or by adding a small quantity of dry sand.

The following constitutes the method used successfully for rearing lepidopterous larvæ:

CARE OF THE EGGS.

The eggs are placed in a jar containing a piece of filter or blotting paper to absorb the excess moisture. The cover is screwed on tightly to prevent any larvæ from escaping when they hatch. Once in every three or four days, the cover is removed for a moment to permit the circulation of air.

CARE OF THE LARVÆ.

As soon as hatching commences, a small amount of food is placed in the jars. Several hundred caterpillars may be placed in one jar, but as they increase in size the number per jar should be decreased in order to prevent overcrowding. After the larvæ have molted once or twice, the filter paper may be removed, and a fourth of an inch of dry sand substituted. The sand is changed every three or four days before it becomes foul or mold develops. The jars should be kept shaded to ensure a nearly even temperature.

CARE OF THE PUPÆ.

As soon as the larvæ have pupated, the jars are cleaned and moist sand is put in. When moistening the sand, just enough water is added to darken it. The covers are screwed down tightly, but are removed every few days to allow a circulation of fresh air. If the sand becomes too moist, the covers are loosened; if too dry, a few drops of water may be added.

CARE OF THE ADULTS.

Before emergence, some bits of coarse hay, dry moss or pieces of paper are inserted into the jars to provide a resting place for the adults as soon as they appear. If perfect specimens of large species are desired the lidless jars are placed in a large wooden or pasteboard box. A stiff piece of paper or cardboard is inserted into each jar so the adults may easily crawl out. This arrangement will provide sufficient room for them to expand their wings and dry perfectly.

MATING THE ADULTS.

Some species of insects mate in almost any situation, but the majority prefer a simulation of their natural environment. These conditions may be provided in a number of ways. One of the most satisfactory methods is to grow the food plant of the species of insect concerned in a box of soil. When matings are desired, a small cylindrical wire screen or lamp chimney is placed over some of the food and the males and females placed thereon. When it is necessary for the adults to feed before mating, sugar-water may be provided. The mating cages should be shaded and left undisturbed until after the deposition of the eggs.

HIBERNATING PUPÆ.

The fruit jars have been used with great success in caring for hibernating pupæ. Species that normally hibernate in the soil are placed in jars filled nearly half full of moist sand. This moisture will ensure sufficient humidity for several weeks. The jars should be opened every week or two to allow a circulation of fresh air. This also assists in the prevention of mold development. Jars with hibernating pupæ have been kept in a greenhouse where the temperature ranged from 60° to 80° F. during the day and from 45° to 55° F. at night with success. The jars should be shaded.

FRUIT JARS FOR REARING BORERS.

The jars may be used successfully for rearing borers from twigs, rotten wood, bark and fungi. Moist sand should not be added in this case, otherwise mold will develop.

FRUIT JARS WITH CHEESE-CLOTH TOPS.

The jars may be used with cheese-cloth covers especially during damp or rainy weather. Such covers have disadvantages compared with the tin tops. Much time is consumed in tying on the cheese-cloth, or if rubber bands are used, they are apt to break and allow the insects to escape. In dry weather the food does not remain fresh by the use of the cheese-cloth tops.

OTHER METHODS.

Caterpillars Reared in Bulk.

If several hundred larvæ of a species, that normally pupate in the soil, are to be reared together, the following method has proven successful:

A pen or corral was made of sheet tin or zinc. This was placed in the soil to a depth of two inches, while the upper edges were tanglefooted or the top covered with cheese-cloth. The tanglefoot prevents the larvæ from crawling out, but cheese-cloth is at times preferable if parasites are abundant.

The mortality from wilt and other diseases is generally quite high in this type of rearing cage because the crowding aids the spread of infection.

Tin Boxes.

Isolated material is often desired, especially in experimental studies. For this work, I make use of small tin boxes with tightly fitting covers, one inch deep and two and a half inches in diameter. These boxes take up very little space, are easily cleaned by boiling in water or by sterilizing, and can be used repeatedly. They prevent parasites from entering and the larvæ seem not to suffer in the least from the confinement. If the boxes are shaded the food keeps fresh for several days or until eaten.

When the larvæ are nearly ready to pupate, a little sand is placed in the boxes. Moisture emitted by the food and larvæ is generally sufficient, but a few drops of water may be added to the sand when needed.

Battery Jars.

Battery jars (Pl. III, fig. 1) with pieces of glass for covers have been quite useful for rearing some insects. The glass covers ensure a high humidity and this naturally keeps the food fresh. Such jars were found to be very satisfactory for rearing silkworms, many hundred having been reared during the summers of 1915 and 1916.

Sand was placed in the bottom of the jars. During damp weather, or when there was an excess of water of condensation, the covers were removed to facilitate evaporation. Silkworms, as is known, do not ordinarily leave their food, so the covers could be removed with impunity.

For rearing wood-boring insects, the battery jars have also been found very useful.

Trays.

Several types of trays, designed at the Gipsy Moth Laboratory at Melrose Highlands, Mass., have been used quite extensively in rearing gipsy moths during the past few years. I have used trays of various sizes and shapes. The trays (Pl. III, fig. 2) were usually made entirely of cardboard or wood with cheese-cloth or paraffin paper bottoms. To prevent larvæ from escaping, the edges of the trays were smeared with tangle-foot. These trays are used extensively, but when a large number of larvæ are reared in a single tray, some difficulty is experienced, for the larvæ often get caught in the tangle-foot and eventually form a bridge over which others escape. The tangle-foot must be repeatedly combed or stirred with a stiff brush. This cleans the tangle-foot and also forms ridges over which it is difficult for the larvæ to escape.

Diseases frequently develop and the mortality is generally high in such trays.

Riley Cages.

I have used a modified type of the Riley cage built for the Gipsy Moth Laboratory, with considerable success. The frames are built of wood, covered with a fine wire mesh. They are provided with removable wooden bottoms and have a door on one side. The cages are sixteen inches square and twenty-four inches in height.

Considerable material, especially Cerambycids and their parasites, have been reared in these cages, from dead wood, etc. The cages were kept in a green-house, in a shaded position, and the wood containing the insects was moistened about once a week.

The cages have also been utilized to some extent for rearing army-worms out of doors. In this case the bottoms were removed and the cages set in soil in a shaded place. If only a small number of larvæ are to be reared, the cages may be placed over the insects' natural food plant, but if one is dealing with great numbers, the food must be renewed daily. The cages are also useful in making matings. Some trouble was experienced by the swelling or shrinking of the cage doors, depending on weather conditions.

Test Tubes.

For rearing fruit-flies of the genus Drosophila, test tubes (Pl. II, fig. 2) have proven very successful. An artificial food, banana agar, was used. This was made by crushing four ripe bananas and allowing them to infuse in 500 cc. of distilled water. The liquid was strained and 7½ grams of powdered agar added. The whole was then cooked until the agar was dissolved. The mixture was poured into test tubes, after which the tubes were sterilized and permitted to cool in a slanting position. Non-absorbent cotton plugs were used. The flies will readily oviposit on this medium and many generations a year may be reared. A piece of filter paper was placed in the tubes for the maggots to pupate upon. Fresh tubes are used for each generation. When newly hatched flies are to be transferred, they are first stupefied with ether.

The banana agar is nearly transparent which enables one to note the feeding habits, etc., of the larvæ.

EXPLANATION OF PLATES II AND III.

Plate II, Fig. 1. Fruit jars used for rearing various insects.

Plate II, Fig. 2. Test tubes used for rearing flies of the genus Drosophila.

Plate III, Fig. 1. Battery jars used for rearing various insects.

Plate III, Fig. 2. Tray with paraffin paper bottom, for rearing insects.

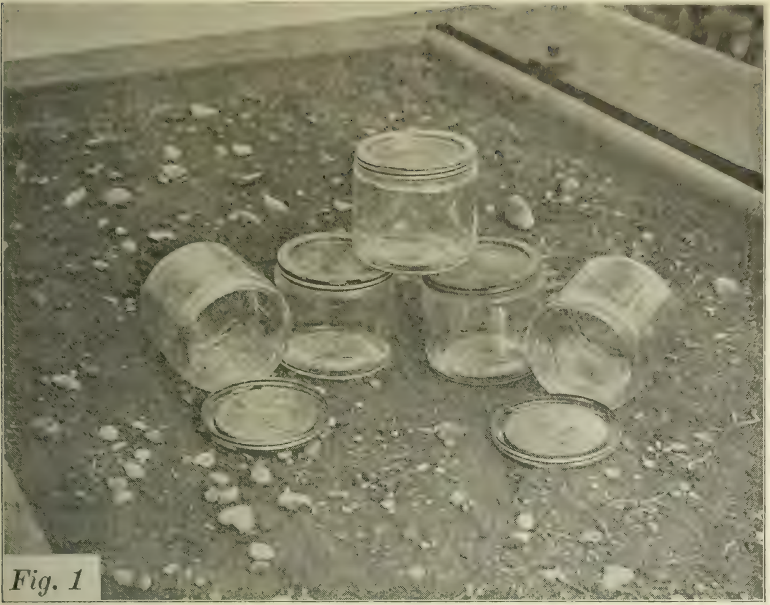

Fig. 1

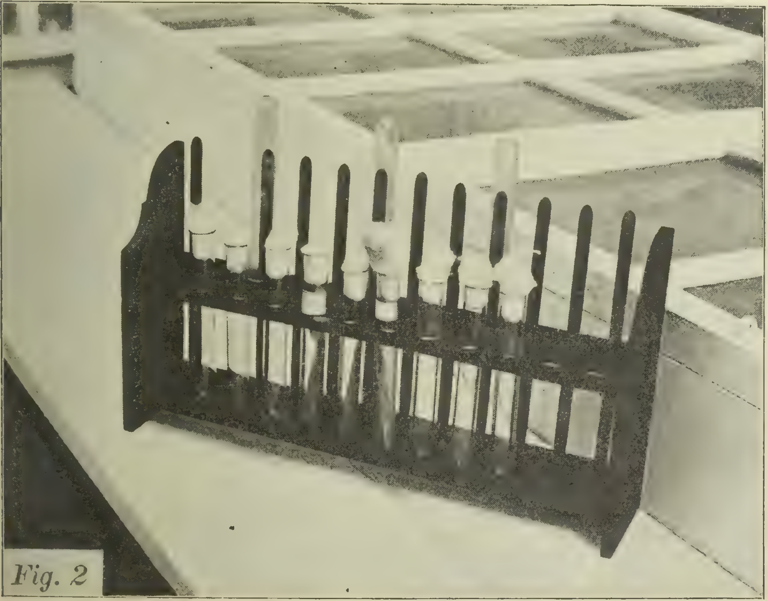

Fig. 2

Wilcox—*Methods of Rearing Insects.*

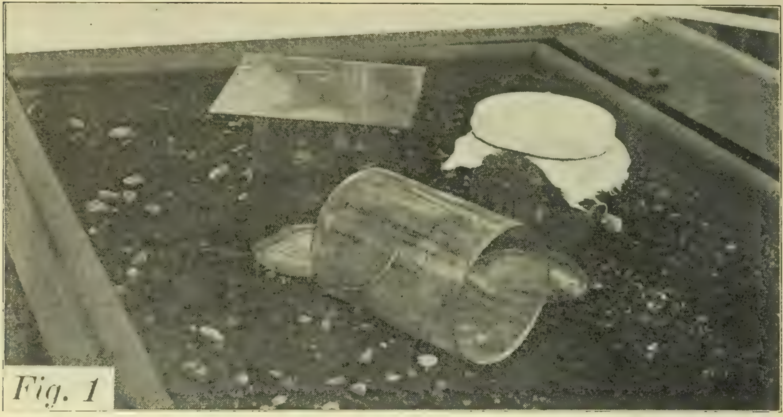

Fig. 1

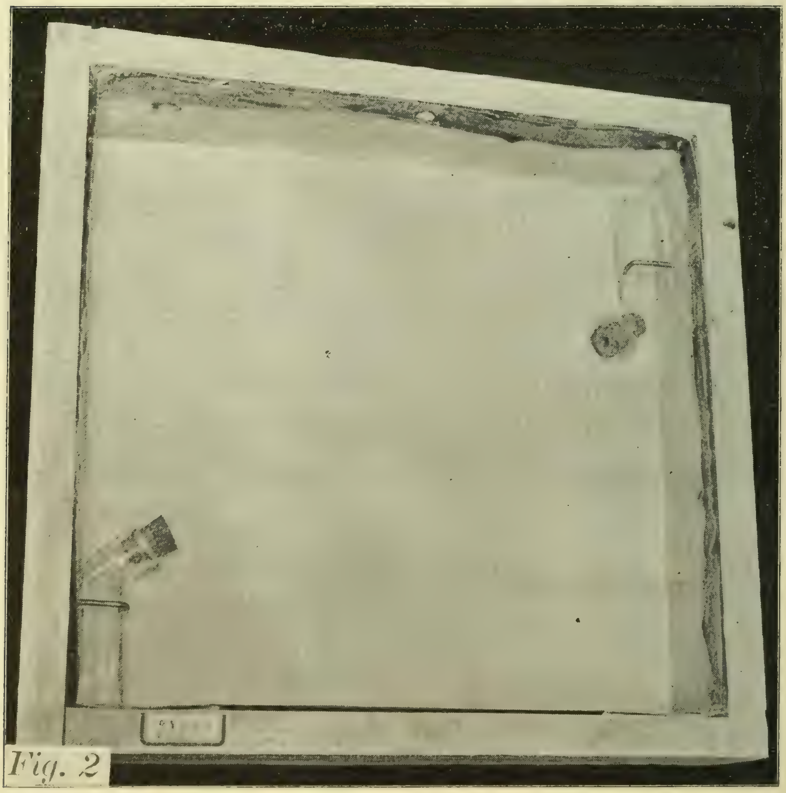

Fig. 2

WILCOX—*Methods of Rearing Insects.*

Three New Species of Evaniidæ.

By Charles T. Brues.

BULLETIN OF THE

AMERICAN MUSEUM OF NATURAL HISTORY,

Vol. XXXV, Art. XXXIX, pp. 717-720.

New York, October 27, 1916.

(Continued from 3d page of cover.)

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ETHNOGRAPHICAL ALBUM.

Jesup North Pacific Expedition.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part 1, pp. 1–5, pll. 1–28. August, 1900. Sold by subscription, price, $6.00.

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Article XXXIX.—THREE NEW SPECIES OF EVANIIDÆ.[1]

By Charles T. Brues.

While examining a collection of Evaniidæ belonging to the American Museum of Natural History, in connection with some other material of the same family, I have found three species hitherto undescribed. The types of two of these are in the American Museum.

Evania carinata sp. nov.

♂. Length 6.5 mm. Entirely black, except for a rufous spot on each mandible, and the palpi, which are dark fuscous. Head above antennæ rugose-punctate; face more rugose-reticulate, with the punctures less distinct; face with a distinct median elevation or ridge extending from the base of the antennæ to near the clypeus; clypeus bluntly pointed, smooth at tip; cheeks separated from the face by a strong curved carina that extends upward on the face for a short distance along the inner eye-margin; no transverse ridge in front of the base of the antennæ; cheeks confluently punctate above, finely punctulate below; head behind eyes rugose-punctate. Inner eye-margins divergent below; ocelli in a triangle, posterior ones twice as far from one another as from the eye-margin. Antennæ inserted a little below the middle of the eye; scape four times as long as the pedicel; both together a trifle longer than the third joint; fourth to sixth joints growing slightly shorter, the fourth nearly as long as the third. Mesonotum coarsely and rather sparsely punctate, the punctures few and widely separated outside the parapsidal furrows, which are distinct. Scutellum with similar, but closely placed punctures. Propodeum reticulated above. Pleuræ and mesosternum confluently punctate; mesopleura smooth above. Metasternal process long, twice as long as broad at middle, scarcely widened apically, with a very strong median carina for its whole length; processes short, scarcely divergent. Hind coxæ punctate. Abdominal petiole deeply, obliquely striate, smooth medially at the extreme base. Wings hyaline; basal vein widely separated from the subcosta, interstitial with the nervulus; cubitus and subdiscoideus wanting beyond the cells. Legs very short, the hind ones, including the coxæ, considerably less than twice as long as the body; middle tibiæ spinulose; hind tibiæ and hind tarsi more strongly so. Longer spur of hind tibia slightly less than half as long as the metatarsus.

Type: One specimen from Moorea, Tahiti. (McTavish Collection.)

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[1] Contributions from the Entomological Laboratory, Bussey Institution, Harvard University, No. 122.

This species is near *rugosiceps* Kieff. but the face is pubescent and not distinctly longitudinally rugose, the mesopleuræ below are strongly pubescent, the hind coxæ coarsely punctate, and the petiole coarsely and but slightly obliquely striate. This is quite similar to *E. meraukensis* Cam. and *E. beauforti* Cam. from New Guinea. The clypeus is narrowed as in the latter, but the face has a median elevated line as in the former. The only Tahitian species, *E. curvinervis* Cam. is quite different from the present form.

Evania rubrofasciata sp. nov. (Fig. 1).

♀. Length 6.5 mm. Black; middle portion of antennæ fuscous, mandibles reddish at middle, palpi piceous or fuscous, thorax ferruginous behind the scutellum and mesopleura, fore and middle tarsi, and hind coxæ below on apical half, rufous. Temples smooth, impunctate; cheeks hardly one-third as long as the eye, smooth, impunctate; face sparsely and not coarsely punctate, with a minute tubercle at the middle, level with the lower eye-margin; face not separated from the cheeks, but with a short furrow extending upwards from the inner edge of the mandible, defining the lateral edge of the clypeus. Eye-margins parallel; antennal basin with a sharp ridge separating it from the face. Antennal scape nearly as long as the three following joints; pedicel one-third as long as the first flagellar joint which is one-half longer than the second. Occiput smooth, sparsely and lightly punctate; ocelli large, in a flat triangle, distinctly closer to one another than to the eye-margin. Head everywhere strongly clothed with white pubescence. Prothorax at the humeri closely and rather coarsely punctate, propleuræ smooth above, coarsely rugose below. Mesonotum with sparse, not very coarse punctures; parapsidal furrows deeply impressed; scutellum sparsely punctate like the mesonotum; propodeum coarsely and regularly reticulate. Mesopleura smooth above, with widely separated very large punctures below; mesosternum closely and less coarsely punctate; metapleura with large round punctures below, reticulate above; metasternum closely, but irregularly punctate, its process with long, curved and strongly divergent prongs (Fig. 1, b). Middle coxæ twice their length from the hind ones which are smooth above, sparsely punctate on the sides and closely so below. Entire thorax, especially the pleuræ, thickly white pubescent. Legs rather long; hind tibiæ and tarsi spinulose, the spinules black; longer spur of hind tibia one-third the length of the metatarsus; claws slender, acutely toothed before apex. Wings (Fig. 1, a) brownish hyaline; basal vein weakly curved, nearly parallel with the subcostal for most of its length; transverse cubitus and transverse discoidal veins interstitial; radial cell longer than usual and but little widened apically. Petiole of abdomen smooth above, below with about half a dozen transverse ridges on the apical third, body of abdomen smooth.

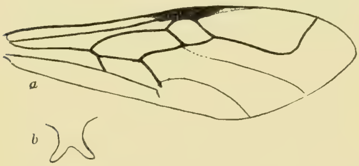

Fig. 1. Wing of *Evania rubrofasciata* sp. nov.

♂. Differs from the female in its more dense white pubescence and in having a distinct shallow longitudinal depression on the face on each side of the median line; these converge above near the base of the antennæ and separate below to meet the impressed lines at the sides of the clypeus. Scape of antennæ two-thirds as long as the first flagellar joint; pedicel transverse; second and third flagellar joints subequal, each one-fourth shorter than the first. Ocelli much enlarged.

A male and female from Walajanagar, North Arcot District, India (A. P. Nathan).

This species is colored much like *E. stenochela* Kieff., but structurally close to *E. nurseana* Cam. to which it will run in Kieffer's key to the Oriental species.[1] The spinules on the tibiæ and tarsi are distinct, but weak, especially in the male.

Chalcidopterella manni sp. nov.

♀. Length 3 mm. Black, with ferruginous markings. Head black above the antennæ, yellowish ferruginous below; scape of antennæ brownish-yellow, prothorax, mesonotum, scutellum and mesopleuræ ferruginous, remainder of thorax black; petiole of abdomen fuscous, with apical third yellow; body of abdomen black, fuscous toward tip; four anterior legs brown, hind pair black; wings hyaline. Head smooth behind the ocelli; front deeply punctate, the punctures well separated, some very large, with smaller ones intermixed; face more closely punctate, the punctures more or less confluent; extending upwards from the lateral margin of the clypeus is a deep, curved impression that extends halfway from the base of the mandible to the lower edge of the eye; these separate a convex median area from the sides of the face; cheeks separated from the face by a fine grooved line; malar space three-fifths the length of the eye; cheeks with a few well-separated punctures; head behind the eyes smooth and polished, with a very few irregular punctures, mainly near the eye margin. Antennæ inserted just below the middle of the eyes; strongly thickened toward apex; scape as long as the three following joints, second and third joints of nearly equal size, third slightly longer; sixth and seventh joints becoming much wider, seventh to tenth but little longer than wide. Ocelli in a low triangle, the posterior ones as far from one another as from the eye margin; eyes rather small, elongate-oval, bare. Mesonotum with distinct parapsidal furrows, coarsely, deeply and separately punctured; scutellum sculptured like the mesonotum; propodeum above regularly punctate-reticulate, with a small smooth elevation just before the insertion of the petiole; posterior surface with large, shallow, hexagonal reticulations, faintly concave medially. Mesopleuræ coarsely confluently punctate below, elsewhere smooth except for a single row of large punctures above; metapleuræ with very large confluent punctures; sides of propodeum with large oblong reticulations below and more or less hexagonal ones above. Petiole of abdomen as long as the distance from the tegulæ to its point of insertion, smooth except for irregular, scattered, more or less elongate punctures on the sides, especially toward the base. Legs short and stout, without spinules on the tibiæ or tarsi, spurs of hind tibiæ stout, differing only slightly in length, the longer one two-thirds as long as the metatarsus. Wings with only a narrow, closed subcostal cell; apex of submedian vein indicated as a short dash or chitinized fleck, elsewhere entirely absent.

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[1] Das Tierreich, Lief. 30, p. 67. (1912).

One specimen collected by Dr. W. M. Mann at Manneville, Haiti.

This form is readily distinguished from any other known species. The presence of a chitinous fleck, indicating the apex of the submedian vein would place it as a member of the genus *Evaniellus* Enderlein which contains a single Peruvian species. This seems to be a very trivial character upon which to base a genus, however, and I have placed the Haitian form in *Chalcidopterella,* from the members of which it is otherwise not separable.

Continued from 4th page of cover.)

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(Continued on 2d page of cover.)

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(*Continued on 3d page of cover.*)

Extract from The Canadian Entomologist, Vol. XLIX, February, 1917, pages 45 to 48.

INSECTS IN OCEAN DRIFT.*

I. HEMIPTERA HETEROPTERA.

BY H. M. PARSHLEY, BUSSEY INSTITUTION, HARVARD UNIVERSITY.

Insects cast up by the waves are often found on the shores of bodies of fresh and salt water, as is well known to most collectors. Specimens found in this way are usually few and scattering, and their presence in the water is probably due simply to an unusually venturesome flight which may have carried them too far for a safe return to land. On rare occasions, however, much more extensive flights may occur, with the result that the shipwrecked are cast ashore in unbelievable numbers, sometimes forming a windrow for miles along the beach. This phenomenon is not to be explained in connection with the spring and fall flights when the air seems alive with insects on the wing, as it has been observed at various other seasons, and for the same and other reasons such flights do not appear to be nuptial in character. Sometimes a violent offshore wind has been held accountable for the presence of the insects in the water, but this explanation will not fit the cases which I have observed; in fact, no satisfactory hypothesis has been advanced as yet. As a knowledge of the species concerned is important in the explanation of insect activity, I append a list of the Hemiptera Heteroptera which I have taken in ocean drift, leaving the list of the other groups for a later paper.

For several years I have spent the summer at Beach Bluff, Mass., during which time I have seen the phenomenon under discussion on only three occasions, each time in the afternoon: June 21,

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* Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 123.

1915, July 18, 1915, and Aug. 1, 1916. In each case there was a light on-shore breeze with fair weather, and in none was the occurrence preceded by an unusually violent off-shore wind, though on the day before the last a moderate land breeze was observed. The insects were not washed up in such enormous numbers as in the cases reported by Needham,* where the shore was blackened by them for miles, but nevertheless the stranded insects were very numerous, in some places forming a continuous line along the beach. The occurrences which I observed were remarkable for the large number of different species represented, with relatively few specimens of each, unlike some of the previously reported cases where the flotsam consisted largely of a single species in enormous numbers. As noted by J. R. de la Torre Bueno in his paper on the subject,† the collector finds in beach drift many species whose retiring habits ordinarily save them from capture, and in the following list are a number whose presence in the vicinity I had not suspected. All the specimens recorded below were taken from the sand immediately on being left by the waves, and I can thus vouch for the fact that all actually took part in the flights over the water. Those marked with an asterisk are mentioned in the list of ocean drift Hemiptera given by Bueno.

List of Species.

Scutelleridæ.

Eurygaster alternata Say, July 4, 1915.

Cydnidæ.

Thyreocoris ater A. & S., June 21, July 18. (2)
T. nitiduloides Wolff., June 21.
T. pulicarius Germ., June 21, July 18. (6)

Pentatomidæ.

**Podops cinctipes* Say, June 21.
**Mormidea lugens* Fab., June 21, July 18. (2)
Dendrocoris humeralis Uhl., July 18.
Perillus exaptus Say, June 21.

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* Insect Drift on the Shore of Lake Michigan, Occas. Mem. Chicago Ent. Soc., vol. 1, No. 1, 1900.

Beetle Drift on Lake Michigan, Can. Ent., vol. 36, 1904, p. 294.

† Heteroptera in Beach Drift, Ent. News, vol. 26, 1915, p. 274.

**Apateticus cynicus* Say, July 18.
**A. bracteatus* Fh., Aug 1.

Lygaeidæ.

**Lygæus kalmii* Stal., July 18.
Ortholomus longiceps Stal., July 18.
**Nysius ericæ* Schill., June 21.
**Ischnorrhynchus geminatus* Say, Aug. 1.
Cymus angustatus Stal., July 18.
C. discors Horv., June 21.
Geocoris bullatus Say, June 21. (6)
G. bullatus discopterus Stal., June 21. (2)
G. uliginosus speculator Mont., July 18. (3)
G. uliginosus limbatus Stal., June 21. (4)
**Ligyrocoris diffusus* Uhl., June 21, Aug. 1. (10)
Rhyparochromus plenus Dist., July 18, Aug 1..

These specimens seem to agree with the description and figure given by Distant in the Biologia Centrali-Americana of a form from Guatemala, but there is some question in regard to the generic reference. I have seen a specimen from Mt. Tom, Mass., and others have been found at Georgetown, Conn., and in the Huachuca Mts. Ariz. For most of this information I am indebted to Mr. H. G. Barber, who spares neither time nor trouble when called upon for assistance in some difficult question relating to the Hemiptera.

**Eremocoris ferus* Say, June 21, July 18. (11)

Piesmidæ.

Piesma cinerea Say, June 21.

Not found heretofore north of Rhode Island.

Tingidæ.

Corythucha marmorata Uhl., July 18.
C. sp. nov., June 21.

The description of this and several other new species of Corythucha will be published elsewhere.

C. cratægi Morrill, Osb. & Drk., Aug. 1.
Melanorhopala obscura Parsh., (Psyche, Vol. 23, 1916, p. 167) June 21.

Nabidæ.

**Nabis ferus* Linn., July 18.

Miridæ.

Miris dolabratus Linn., June 21. (2)

Platytylellus sp.?, June 21.

Neurocolpus nubilus Say, Aug. 1.

Pœcilocapsus lineatus Fab., July 18.

Capsus ater Linn., June 21. (4)

C. ater semiflavus Linn., June 21.

Camptobrochis grandis Uhl., July 18. (7)

Gerridæ.

**Gerris marginatus* Say, July 18. (4)

Saldidæ.

Saldula major Prov.

S. pallipes Fab., July 18. (2)

S. sphacelata Uhl., June 21.

S. opacula Zett., July 18.

S. sp.?, June 21, Aug. 1. (3)

**Micracanthia humilis* Say, June 21, Aug. 1. (9)

Some of these were taken under seaweed where they were very numerous on Aug. 1, though not so ordinarily. Stranded specimens were very active as soon as they left the water, and probably those under the seaweed had taken temporary refuge there after escaping the waves.

Corixidæ.

Corixa verticalis Fieb., July 18. (2)

Kindly identified by Prof. J. F. Abbott.

It is well known that some insects can withstand prolonged submergence in salt water, but from the condition of the more fragile species, many of which gained the shore alive, it seems to me probable that the flights occurred on the same day, shortly before the insects were washed ashore. If this be true, a possible explanation of the flights presents itself. On a clear day with a light, on-shore breeze the surface of the ocean reflects the sunlight with a peculiar sparkling brilliancy which might conceivably attract insects already flying above the land in unusual numbers because of some favouring combination of atmospheric conditions. The absence of the latter factor would account for the lack of a flight on days which were otherwise favourable. Thus, a light, on-shore breeze rather than a strong, off-shore wind may be the more frequent cause of the flight of insects over the water, and their consequent presence in the drift.

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NOTES ON THE LIFE-HISTORY OF SOME NORTH AMERICAN LAMPYRIDÆ.[1]

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Introduction.

This paper represents the biological portion of two years' work at the Bussey Institution on several species of beetles of the subfamily Lampyrinæ or true fireflies. The portion dealing with the embryology, and the structure and development of the light-organs of two common species, *Photuris pennsylvanica* DeGeer and *Photinus consanguineus* Leconte, together with illustrations of these two fireflies and their early stages, has recently appeared in the Journal of Morphology. The observations on the life-histories were made throughout the year but especially during the summer both in the field and in the laboratory. For collecting Lampyrinæ and particularly their larvæ, a small electric flashlight was found to be indispensable.

I wish to thank all those who have helped me in my work and especially Dr. Wm. M. Wheeler for many helpful suggestions and criticisms.

Previous Biological Work on Fireflies.

Comparatively little work has been done on the life-history and habits of American fireflies. In Europe, where more is known of the Lampyridæ than in our own country, *Lampyris noctiluca* L. has furnished more data than any other species. The male of *noctiluca* is fully winged but only faintly luminous, the female, on the other hand, is apterous and larviform and glows brightly. Newport, whose work was done from 1830 to about 1842, furnished a good general account of the life-history of this glow-worm. Olivier (1911, etc.), Fabre (1913), and others have also contributed biological data, but the most recent publication is that of Vogel (1915), who gives data on the larva of *Lampyris noctiluca* in relation to its life-history, and an excellently illustrated description of the external anatomy, as well as the structure of the mouthparts, pharynx, gizzard, etc. Especially valuable is the portion relating to the operation of the mouth-parts in connection with the poisonous secretion which is emitted through the mandibular canal.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 124.

Among those who have contributed to the life-history of North American Lampyridæ, Barber (1905 and 1914), Mast (1912), and McDermott (1910–1912) are deserving of special mention.

Photinus consanguineus Lec.[1]

This is a rather slender, quite depressed insect, with the head well retracted under the prothorax. The antennæ are eleven-jointed and moderately slender, and the eyes are larger in the male than in the female. The prothorax is rounded anteriorly and at the sides, and truncate behind, with the posterior angles rather acute, the disc is convex with the margins broad and thin. The elytra have rather narrow side margins and two or three subobsolete carinæ, the legs are rather short, with the femora and tibiæ rather compressed. The abdomen is depressed, and in the male, bears the light-organ on the sixth and seventh sternites, while in the female it occupies the greater part of the seventh sternite. The head is largely blackish, the thorax yellowish, with a broad black median bar on its posterior half and bordered on each side with pinkish. The elytra have the suture and side margins pale yellowish, the legs are brownish and the abdomen, except for the pale yellow luminous area and the pale segments beyond on the ventral side, is blackish. The elytra are granulate and rather densely pilose, while the antennæ and the legs have short, glossy brown pile. The beetle measures from 8 to 12.5 mm. in length.

During June and July, this firefly is very abundant about Boston, and in the evening may be seen flashing its yellowish light in the low moist meadows. The males are active though not rapid flyers, but the females, while provided with wings, are not taken in flight. It is evident that the light-organ (situated on the sixth and seventh sternites in the male and occupying the greater part of the seventh in the female) serves as a secondary sexual character, but it is difficult, if not impossible, to explain the purpose of the larval light-organ. The mating responses of fireflies have been studied by McDermott (1910–

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[1] *Photinus consanguineus* Leconte; Proc. Phil. Acad. Nat. Sci., V, 335, 1851.

1912), and by Mast (1912), among others in this country. I can add but little to their observations. The males of *Photinus consanguineus* are on the wing shortly before 8.00 P. M., and a half hour later the flashing is at its height, while after 9.00 P. M., there is a decrease. The female crawls up some weed or grass stem and emits a single strong, diminishing flash in response to the three or four flashes at rather long intervals, of the male, which may be flying nearby or perched on an adjoining weed. I can do no better than to quote Mast (p. 267–268): "The luminous or photogenic tissue in the female as previously stated is confined to a small area on the ventral surface of the third segment from the end. Just before the female glows in response to the flash of light produced by a male she raises and twists the abdomen so as to direct the ventral surface, the source of light, toward the male. If the male is directly above she twists the abdomen nearly through 180 degrees, if to the right or left through 90 degrees, etc. Only when the male is directly below does the female glow without twisting the abdomen. These responses occur in the western Maryland species, almost invariably, and they are so striking that they cannot be readily overlooked." This species flashes but once in either sex. Further observations by McDermott show that different species of *Photinus* have a characteristic mode of flashing. In *Ph. consanguineus,* in the few instances under my observation, the male, in response to the female, would alight near the latter and search about excitedly, flashing in the meantime, and the female would respond in a rather feeble manner to the male, but a few inches away. Often considerable time elapsed before the male found his mate.

Neither sex was observed to eat anything, nor could the stomach contents of alcoholic specimens be determined. Bowles (1882), speaking of *Lampyris noctiluca,* a European genus allied to *Photinus,* says: "The perfect insect is herbivorous and feeds only on the tender leaves of plants; but the larva is voracious in its habits, devouring snails, slugs and soft-bodied insects."

Ph. consanguineus oviposited readily in captivity, but the number of eggs laid by a single specimen was not ascertained. The eggs are deposited among fine grass roots or a short distance in the soil. The egg measures about 0.750 by 0.666 mm. It is dull creamy white, and smooth under a hand lens. A thin membrane with oil-like dots envelops the chorion. The egg is at first quite soft and often considerably flattened against the surface to which it adheres by the viscosity of the outer membrane. Newport ('57), speaking of *Lampyris noctiluca,* states that at the moment of laying, the egg is covered with a very adhesive sticky matter. Later the egg becomes firmer and loses much of this stickiness. The laboratory period of incubation was from about thirteen to fifteen days, a large batch of larvæ hatching about July 24 in 1913. According to Newport, the egg state of *Lampyris noctiluca* is about nineteen days. Vogel ('15) says that oviposition of the same species usually occupies two or three days and incubation twenty-seven to thirty, thirty-six, and even forty-seven days, according to the temperature of the summer. *Photinus* larvæ which are ready to emerge have conspicuously black eyes and brown mouth-parts.

When freshly hatched the larva is about 2.35 mm. long, and whitish, except for the blackish eyes and brown mouth-parts. Soon it becomes slaty gray with the head largely brownish. Its length, exclusive of the retractile head, a few days later is 2.5 mm., and the width at the second thoracic segment is 0.6 mm. The form is oblong-elongate, broadest at the thorax and thence tapering gradually toward the caudal extremity. The body is depressed, and rounded-carinate mesially. There is also a subdorsal carina on the thorax, which is less distinct on the abdomen and which marks the course of a pale stripe. The head is about half as wide as the prothorax and nearly or quite as long as the latter; the antennæ are three-jointed, the third joint is strongly chitinized and bears one globular and one cylindrical sense-organ distally. The mandibles are arcuate, with a finely pointed tip and a projecting preäpical internal ridge. The legs are slender and spinose, and under high magnification the body appears roughly granulate. The single pair of prolegs is strongly multifurcate, and the many filaments are thickly armed with rows of ventral hooks, which occur also along the base of the furcation. The larva has well-developed light-organs in the form of two small lenticular structures in the ventral portion of the eighth abdominal segment. These glow with a yellowish light.

The duration of the first instar of *Lampyris noctiluca* is about fifteen days according to Newport ('57). The first moult occurs nineteen days after hatching. Under artificial conditions I found the young *Photinus* larvæ quite delicate, and I was able to carry but few over into the third instar. When ready for the first moult they are about 3 mm. long. I kept these insects in a jar of moist earth and fed them flies which were cut up so that they could be devoured more easily. Several larvæ would gather about a fly and bore their way into it till their heads and a portion of the prothorax were hidden from view. They remained thus for some time, so that when a day later I examined the larvæ, I found them all dead from suffocation. Like *Photuris,* they pass the greater part of two years as larvæ, and like the former, the same brood is sometimes characterized by the unequal growth of some of its individuals, so that there are larvæ which probably require less and others more than two seasons to produce adults. No first-year larvæ were taken in the field. Newport, in rearing *Lampyris noctiluca,* noticed different rates of growth among the larvæ under apparently the same conditions. He adds that they may not all mature the same year, for as much as one year and nine months may elapse before full growth is attained.

The full-grown larva is about 13 mm. long, exclusive of the head, and with the head extruded, 14.5 mm. The head is depressed, subcylindrical, somewhat longer than wide, and about half as wide as the prothorax. The antennæ are three-jointed, with two terminal sense-organs. The body is slender and depressed and a little wider at the middle. The tergites are heavily chitinized and coarsely punctate and rugose, while on each side of the dorsal median line is a rather indistinct carina, most evident on the thorax and tending to disappear posteriorly. The legs are slender and the prolegs very much divided into dichotomously branching filaments. The dorsum is shining black, the ventral sclerites are smoky brown and the membrane is dirty whitish, with the exception of the venter of the thorax as well as the sides above the lateral line, where there is often a decided suffusion of pinkish. The legs have the chitinous portion testaceous. The head is black and the mandibles reddish brown. The body has rather sparse yellowish-brown hair. The adipose tissue gives the anterior part of the body a pinkish tinge. The larvæ of *Ph. pyralis* (Rep. N. J. State Mus., p. 298, 1909) and *Ph. modestus* (Kellogg's American Insects, p. 269) much resemble that of *consanguineus.*

It seems evident that a larva of the form of *Photinus* is not so well fitted to lead an active life above ground as that of *Photuris.* As a matter of fact, it is much more subterranean in its habits and therefore less frequently seen and taken. It also inhabits damper situations. Larvæ were found in the fall, winter and spring of the year, but most abundantly in the fall. Upwards of one hundred were secured, mostly from September 8 to October 5, 1913. On March 20, 1915, a few hibernating individuals were taken in a moist field, where they lay buried a few inches in the soil. They occurred in a small hummock which remained unfrozen. Active specimens were found on May 11, 1914. On warm summer nights as many as fifty could be taken in two hours. Some of these larvæ were a little off the ground, crawling along blades of grass, while others were creeping about the damp soil. They occurred most plentifully in the earth-choked channel of Bussey Brook at Forest Hills, Boston. In May, 1914, the low meadow, where I procured larvæ the preceding year, in many places stood an inch or more under water, which must have forced many of the insects out of the soil, for some were found a short way up stems while a small hummock yielded others.[1] The larvæ are more or less gregarious, at least during the later stages, for they gathered together in captivity, and were taken singly or more commonly in small groups under wood or other debris in their habitat, while another species of the same genus was found in some numbers under a sheltered piece of decayed wood. It would seem that their life is largely subterranean, and that they come to the surface only under more favorable conditions or during excessive moisture. In the laboratory large larvæ throve with very little care in a jar of moist earth. At long intervals they were fed with earthworms which they paralyzed after the manner of *Photuris*. But they were by no means as voracious as the latter.

The pupal stage is quite brief. Pupating larvæ lose their bright color, shorten up a little and assume an arcuate position. The skin splits down the anterior part of the back and gradually liberates the pupa. The latter is formed under the soil.

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[1] In this connection it is interesting to note that Annandale, '00 and '04, twice found an aquatic lampyrid larva in lower Siam, and once in the suburbs of Calcutta. In the case of the Siamese specimens, the luminous organs were two small oval patches on the ventral surface of the last abdominal segment. As in other lampyrid larvæ the light shone steadily, though it was of a brilliant blue color. Many fireflies were flying over the marsh where Annandale took some of the larvæ. The latter he found clinging dorsal surface downwards to floating fronds of a small cryptogam. They ceased to shine on being taken out of the water, but the luminescence was resumed upon immersion in the liquid. No special respiratory organs nor air-silvered areas were found. He did not rear the larva to maturity.

The pupa, straightened out, measures about 11 mm., and in an arcuate position, 8 mm. It is depressed subcylindrical, with the appendages rather short and the lateral tergites only slightly drawn out and hardly reflexed. It bears, especially along the edges of the segments, some short and quite sparse hairs. The general color is yellowish white with a considerable suffusion of pinkish, especially along the abdomen. It is much less active than the pupa of *Photuris,* and, unlike the latter, never has a general effulgence. The larval light-organs shine steadily during the pupal life but are somewhat smaller and are rather more evident during the earlier than in the later pupæ, where the cuticula is much pigmented. By the time that the perfect insect is freed there is usually little or no luminescence in the larval organ.[1] Laboratory specimens which pupated during the winter were nearly all females.

Photinus scintillans Say.[2]

This species occurs more rarely in the neighborhood of Boston than *consanguineus,* and is found on drier, higher ground, often associated, though to its own detriment, with *Photuris pennsylvanica.* Besides differing from its congener in its smaller size and more slender legs, as well as paler color, the male may also be distinguished by the fact that it (as well as the female) emits but a single, rather long flash to the three or four flashes of the male *consanguineus.* The female seems incapable of flight, and specimens are often met with having the abdomen protruding far beyond the elytra. The semi-gregarious larvæ are paler and more suffused with pinkish than *consanguineus* larvæ. A few of the larvæ were found upon the surface of the ground, and several large ones, superficially buried in the light soil, were taken in the evening.

Ellychnia corrusca Linn.[3]

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[1] In some cases at least, there is a rather brief period in the pupal stage during which neither the larval nor the adult photogenic organs glow. Such a case was observed on December 14, 1913. A pupa, apparently less than a day from hatching, could not by rough handling, jarring, etc., be induced to give any light whatsoever, though the adult organ was plainly visible.

[2] *Photinus scintillans* Say, Journ. Phil. Acad. Nat. Sci., V, p. 163, 1825.

[3] *Ellychnia corrusca* Linn., Syst. Nat., Ed. XII, 644, 1785.

This is a very common firefly, a rather broad flat species, with a small retractile head, slaty black elytra and a pinkish stripe on each side of the disk of the thorax. It belongs to the *Photinus* group, and like the members of that genus, is capable of giving forth a viscous milky exudation and of clinging tenaciously to one's fingers. But it differs rather widely in its habits from *Photinus,* as will be seen from the following.

Ellychnia corrusca is most conspicuous in spring, appearing on tree trunks in New England, as early as April, and may be met with when autumn is merging into winter. Like the smaller variety *autumnalis,* it hibernates in the adult state, seeking refuge from the cold, beneath stones, in decaying logs, under tree burlapping, and beneath the looser moss about the base of tree-trunks where at times it congregates in considerable numbers. It is a decidedly hardy insect and, given the proper condition, a very large per cent. of the autumn individual seems to hibernate successfully. I confined 18 specimens (♂ and ♀) in a small brass box filled with moss and provided with a screen cover, and in late November placed it outside a window with north exposure where it remained until the middle of April. The box was brought in from time to time, slightly warmed and the beetles examined. Not all the *Ellychnia* were thus brought out of their torpor during these brief spells, but the activated beetles were very thirsty and drank eagerly from the moss which I had moistened. Of these 18 beetles exposed to temperatures that fell more than once below zero Fahrenheit, 16 were alive and healthy at the end of April. Mating takes place when the beetles are well out of hibernation. The earliest record I have in captive specimens is May 7, 1916. This pair, with other beetles, were previously given banana peel, the soft inner portions of which they consumed to some extent. As adults they are probably purely phytophagous.

The female oviposits readily in captivity. The egg is practically spherical, creamy white, and like that of *Photinus,* provided with a viscid outer membrane. It is faintly luminous for a time at least. The young larva much resembles the *Photinus* larva, though it is possibly a little broader. I was unable to rear it beyond the first moult. There are two luminous points on the eighth sternite, but these are not so pronounced as in young *Photinus* and *Photuris,* and in the same individual are sometimes fainter on one side than on the other or they may not always be visible. I know nothing of the later larval stages or of the pupa.

The adult beetle is commonly regarded as non-luminous, and indeed this seems to hold true of the greater number of individuals. One evening while I was examining a jar containing a number of them, a single male was observed to bear a pair of faint yellowish lights, hardly to be perceived beyond an arm's length, on the eighth abdominal sternite, *i. e.,* in the very same position and segment as the larval lights. The glow was steady and sustained. This male was the only specimen which shone (or could shine) of its own accord, but by rough handling I was able to induce four other specimens to produce a very faint and evanescent glow. It seems probable that the organs are almost non-functional or vestigial and represent those of the larva. In the adult the chitin beneath, *i. e.,* ventral to the light-organs, instead of being transparent, is strongly pigmented.

Lucidota atra Fab.[1]

This, like the preceding species, is diurnal, and in early summer may be seen clinging to herbage or in slow flight. It is a delicate, rather broad, depressed insect, 8–11 mm. long, with the antennal joints broadly flattened. The general color is black with the lateral edges of the prothorax broadly pinkish and yellowish. I found this insect abundant at Melrose Highlands, Mass. It is luminous in all its stages, although sometimes when freshly emerged it does not glow strongly as an adult insect.

The dull whitish eggs are subspherical and hardly differ from those of *Photinus.* The larva also is rather similar, but differs in being slightly more flattened above, and in the more angulate tergites which are dilute or grayish black instead of shining black. The larva of *Lucidota* is rather more suffused with pinkish but may be most readily separated from *Photinus* in having the lateral edges of the last two abdominal tergites very broadly whitish carneous. This pattern, situated as it is on the luminous segment, permits the brilliant yellowish green light on the eighth abdominal segment to shine dorsally as well as ventrally. The light is readily controlled and may not be used for a long period even though the insect be roughly handled. Larvæ in confinement often flash out quite suddenly if dis-

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[1] *Lucidota atra* Fab., Ent. Syst., I, 101, 1798.

turbed and this is striking when they are in some numbers. Such sudden effulgence subsides rather gradually. Only half-grown to full-sized larvæ were found. These were often taken gregariously in the fall, winter and early spring in moist earth and rubbish, decaying stumps and under stones. The pupa, in conformity with the adult insect, has the abdominal segments drawn out posteriorly, both latero-dorsally and latero-ventrally. With the exception of the dull glassy head, appendages and tip of the abdomen, it is of a delicate roseate color. It is very active at this stage. Pupæ may not shine at all times and when shining may do so with varying intensity. In one case the luminous points appeared to be on both the eighth and ninth segments but more intense on the latter. In addition, some of the pupæ when disturbed gave forth a diffuse body glow. This recalls the glow of the *Photuris* pupa. Freshly hatched adults of both sexes shone better than older specimens, though neither did so at all times. A freshly emerged female on being handled emitted a diffuse yellowish-green light, the whole abdomen and at least the clearer lateral pieces of the prothorax being involved. The light seems to be under rather slow control and suggests that the adult may be partly nocturnal. The insect hibernates in the larval stage.

Pyractomena sp.

During the afternoon of April 19, 1916, while engaged in field work for the Gypsy Moth Laboratory of the Bureau of Entomology, I took this large and somewhat remarkable lampyrid larva at Hanson, Plymouth Co., Mass., as it was ascending the trunk of a large white oak (*Quercus alba*), at a height of four or five feet. This tree, with numerous others, formed a grove in a low, rather moist area.

The length of the larva, exclusive of the head, is 22 mm. The head is very small in proportion to the size of the body, for while decidedly elongate, its very narrow and nearly cylindrical form gives it the appearance of a dark, shining rod or tube. It is furnished with a pair of sharp-pointed, sickle-like mandibles which are somewhat upcurved at their distal end. The body is rather flattened fusiform but more narrowed posteriorly. The prothorax is by far the longest of the segments, being as long as or longer than wide and drawn out and narrowed anteriorly into a sort of neck. The thoracic legs are long and slender and strongly clawed. The rather indurate tergites have their posterior lateral angles somewhat pointed and drawn out. The pleuræ and venter are partly membranous. The last abdominal segment is provided with a highly developed pair of fleshy, retractile and multified prolegs. The tergites are variegated wood-brown, with a dark streak bordering the paler median line. Ventrally it is more pinkish. The insect bears some resemblance to a slender larva of *Photuris* and is undoubtedly predaceous and to a degree a climbing insect. The elongate, almost minute head, which tortoise-like, can be retracted far out of sight into the prothorax, would appear well fitted for exploring crannies in the bark, etc., for prey, while the long thoracic and much divided anal prolegs facilitate its scansorial habits.

I kept the larva in a tumbler partly filled with loamy soil, which, having previously contained a lepidopterous larva, had the sides more or less spun over with silk. Towards the first of May, the *Pyractomena* had crawled up near the top of the tumbler and evidently by means of an anal secretion or a dried-up liquid of some sort had firmly suspended itself, venter towards the glass, by the tail. Its head was retracted (the pupating *Photuris* larva has the head extruded) and the two ventral lights on the eighth abdominal segment were often visible, and frequently most of the membranous portion of the body facing the glass showed a delicate effulgence. When I disturbed it the effulgence would brighten up considerably and so would the two tail lights. After having remained suspended in this quiescent stage for the matter of a week it transformed into a large pupa, the larval skin splitting laterally or ventrally and not dorsally, as with pupating Lepidoptera, and remaining shrivelled and attached to the posterior portion of the abdomen. The remarkable thing about this pupa, apart from its being suspended, is its darkly pigmented condition, which strongly suggests that it is always formed above ground and in a situation exposed to light.

The pupa is moderately stout and only slightly arcuate; the pronotum is long, and the tergites have their lateral posterior edges somewhat reflexed and pointed, making it appear rather spinous. The pronotum bears a yellowish white median line, which is bordered by a wider blackish stripe, beyond which is a wide yellowish-white edge. The remaining tergites as in the dorsum of *Photinus* larvæ are shining black and have a rather wide, dull yellowish-white median line while ventro-lateral to the tergites there is much pink. The leg- and wing-cases are blackish. The abdomen in its softer portions is dull yellow and pink and has a brown sublateral stripe.

The comparatively long duration of the prepupal stage may partly account for the dark color of the pupa.

Judging from the single specimen I have observed this *Pyractonema* must differ rather widely in its habits from *P. lucifera* (see Wenzel, 1896) which lives in salt marsh meadows among snails.

Photuris pennsylvanica DeGeer.[1]

The adult beetle is elongate and rather flattened, the head is somewhat retracted under the prothorax, the antennæ eleven jointed, slender and tapering, and the eyes large. The thorax has the disc convex, with broad thin margins, and is rounded anteriorly and along the sides and subtruncate posteriorly. The legs are slender, the outer tarsal claw is bifid; the elytra are rather acute at the tip and extend well beyond the extremity of the abdomen. The general color of the head is dull yellow, with a black area on the posterior part of the vertex. The pronotum is dull yellow with the disc red and a median black stripe, while the rest of the thorax is very dark brown. The legs are paler at the base of the joints and at the apex of the femora, while the elytra are brown or piceous, with the suture, side margins, and a narrow tapering stripe on the disc, pale brownish. The abdomen is blackish brown with the posterior border of the fifth and all of the remaining sternites, yellowish. The luminous organs are yellowish and are situated on the sixth and seventh sternites. They are larger in the male. The body is clothed with fairly abundant yellowish pile, which is darker on the legs and most conspicuous dorsally. The pronotum and the elytra are densely and rather coarsely punctate. The length varies from 11 to 15 mm.

This is the largest and commonest of the brilliant New England fireflies, and from early June till the end of July, or the first week of August, both sexes may be seen along the borders of woodlands, flashing their yellowish-green light. The habitat of this species is therefore unlike that of the abundant *Photinus consanguineus,* which frequents low moist meadows. While it is true that *Photinus scintillans* flies with *Photuris* in this locality, owing largely perhaps to the voracious appetite of *Photuris*, it does not flourish alongside its larger neighbor. Only a few *Photuris* were found in the *Photinus consanguineus* locality. As in other Lampyridæ, *Photuris* has more or less well-defined centers of distribution, areas fairly scintillating with their lights, which elsewhere are more scattered or absent. These places, where on favorable evenings the larvæ can be found in abundance, are evidently the ones in which they pass their early stages.

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[1] *Photuris pennsylvanica* DeGeer, Mem. Hist. des Ins., IV, 1768, 52.

Both sexes of *Photuris* fly readily and rather high, but the males are more often seen on the wing than the somewhat terrestrial females. In July, the flight begins from a little before to a little after 8:00 P. M., and most of the males have settled by 9:00 P. M. While there is considerable uniformity as regards the number of flashes emitted by these insects, exceptions are common. As a rule, the males flash three or four times to a period, and the last flash is usually the least intense. Each flash is of about a second's duration, and separated from the next by considerably less. Some flash twice, another will give six very rapid flashes, but the number seems constant for each specimen. It was estimated that when in flight, the males flash for every fifteen feet traversed. They may scintillate in this manner when resting on trees or weeds. The flight of the female is more rapid and direct than that of the male, and her flashes are less intense and somewhat more variable. While on the wing she was observed emitting a dim though steady light. When alighted she flashes once or several times. In the latter case the intervals are longer than in the male.

While there seems to be little doubt that the light emissions play an important part in bringing the two sexes together, it seems equally clear that by itself, this function is less necessary in *Photuris pennsylvanica* than in the various species of *Photinus* studied by different observers. No exchange of light flashes was made out with certainty in the case of *Photuris,* and none occurred during copula. The female while shining does not necessarily assume a vertical position, as do *Photinus* and some of the European species, nor does she curve up the tip of the abdomen as in the latter. In the evening the females were usually resting in a more or less horizontal position, upon some bush or weed, or upon the ground, and the brilliant flash shone appreciably through the elytra. The photini were much less active than the photuri, and were able to cling firmly to weeds, etc. The latter are very nimble runners and restless insects, so that the sexes should readily find one another.

When captured or roughly handled *Photuris* frequently exudes a pale honey yellow fluid from between the last coxal joints; this "blood" likewise exudes when the elytra are cut. In *Photinus, Ellychnia* and *Lucidota* the fluid is whitish and more viscous and flows even where the elytra may be flexed. The exudation is probably protective. The female oviposits for several nights and requires an abundance of food for her sustenance and for the development of the eggs which are in several stages of growth in her ovaries. Her appetite, to say nothing of cannibalism, is worthy of note. The male, on the other hand, seems to be a sparing eater. On several occasions a female was discovered perched upon some convenient stem, leaf, or upon the ground, devouring a male *Photinus scintillans*. One evening six females were disturbed at such meals. The fact that the victims were always males, though the females were nearly as abundant in this locality, and that the feeders were invariably females, strongly suggests that the weak *Photinus* males were drawn to their untimely ends by the lure of the greenish-yellow light of the female *Photuris*. When bottled up with *Photinus* they would readily devour the latter, despite its active exudations. When confined in the laboratory, a female would frequently overcome and devour a male of her own species, less often she would attack one of her own sex and cling tenaciously to her actively running prey. The males would not feed in captivity.

Oviposition was not observed in the field and was seen but once in the laboratory. The female thrusts her long ovipositor a few millimeters into the soil to lay the sticky, pale yellowish egg. Eggs laid in the laboratory, or better, by specimens confined in shady places out-of-doors, were deposited in the soil or among the roots of grass, either singly or in small groups. The egg, while not constant in size, averages about 0.784 by 0.677 mm. Its pale yellow color serves to distinguish it from the whitish egg of *Photinus* and *Ellychnia*. Under a hand lens it is polished, under a high magnification it has a finely dotted appearance owing to the presence of a thin membrane which contains oil-like globules and gives it the adhesive properties. When first laid the egg is soft and often more or less flattened against an object, later it grows and rounds up somewhat and develops a firm and brittle shell. Long ago Newport (On the Natural History of the Glowworm, 1857) noticed the growth of the laid eggs and found them to be effulgent. Seaman (1891) says: "The eggs of the Lampyridæ and Pyrophori may be dried to their utmost without losing their photogenic property." Dubois (1898) adds that the eggs of *Pyrophorus noctiluca,* the large luminous Elaterid of the neotropical regions, shine when unfertilized, and even while in the ovarian tubes. He states that they have great affinity for moisture and will even glow when placed near a green blade of grass. Mr. H. S. Barber writes me (June, 1914) concerning *Phengodes laticollis* that "luminosity develops in the egg before hatching." The eggs of *Photuris pennsylvanica* certainly glow when deposited, and till they are from two to four days old, and therefore probably throughout their life, but the effulgence is often so faint that it can be perceived only by careful and protracted scrutiny in total darkness. In July, 1914, I squeezed several eggs out of the ovary of a living *Photuris,* and placing these in water, carefully examined them in the darkness. But they were not found to shine and so they were crushed and placed in hydrogen peroxide, when at least one egg emitted a faint luminescence.

In the laboratory eggs of *Photuris* hatched in about fifteen to eighteen days, into peculiar, very active, somewhat turtle-shaped larvæ about 2.20 mm. long. At first whitish, except for the blackish eyes and pale yellowish-brown of the feet, mouth-parts and antennæ, the larva darkens in the course of a day or two and becomes slaty gray with the head largely brownish. The length of the body is now about 2.50 mm., including the extended head 2.70 mm., its width at the third segment 1 mm. The head is depressed cylindrical, a little more than twice as long as wide and hardly one third the width of the prothorax. The eyes are simple and rather large, the antennæ short, tapering and three-jointed, the first joint is membranous and the third bears a cylindrical sense-organ distally and a lobed process before the end. The jaws are stout, arcuate and notched before the tip. The body is oblong oval, tapering more caudally, with the sides above depressed, forming a rather prominent median ridge; the prothorax is about as long as the meso- and metathorax combined, the latter two are each longer than any of the abdominal segments with the possible exception of the ninth; the abdominal segments particularly, have the sides drawn out and curved posteriorly and armed at their apices with long strong spines; spines also occur sparingly on the dorsum, and smaller ones are scattered over the body, which is finely and irregularly granulated. The legs are slender and spinose, the tarsal claws simple though spined basally. The prolegs, of which there is but a single anal pair, have each side subdivided into six slender furcate processes and an inner shorter and stouter furcate process. All these sixteen processes are armed with rows of recurved hooks. The prolegs are less divided than in *Photinus,* and can be extended fanwise to serve both as an organ of propulsion and of adhesion, the tiny hooklets giving the insect a firm hold. The abdominal prolegs of beetle larvæ have been much studied by Brass (1914). He terms the organ, which is a development of the tenth abdominal segment, the seventh foot, and says that it finds its highest modification in the lampyrid *Luciola italica,* which has the proleg dichotomously branched into one hundred and twenty filaments. Brass suggests that it owes its development to the unsupported weight and extent of the abdomen. When fully expanded the soft fleshy foot covers a large area, and while not in use is protected by being completely withdrawn into the body cavity.

Photuris pennsylvanica uses its prolegs extensively in climbing weeds, and also employs them to brace itself, though often ineffectually, against the pull of its struggling prey. Occasionally it will curve the end of the abdomen over its back and use the finely divided seventh foot as a broom with which to clean its dorsum. This has also been observed in some European Lampyridæ, by Targioni Tozetti (1865), Berlese (1909), Fabre (1913), etc. Species like *Lampyris noctiluca* that feed upon snails, thus wipe off the slime which has soiled them.

The larva of *Photuris* is capable of enduring considerable drought and of surviving for some time without food. Specimens which hatched about July 27, 1913, were offered cut-up insects, chiefly flies, which they devoured in the evening or in artificial darkness, hiding during the day in crannies and under lumps of earth. In feeding, they congregate about their food in some numbers and inserting their small extrusible heads into the victim soon convert it into a mere shell.

From August 8 to 10, approximately, most larvæ of this brood had passed into the second instar, having undergone one ecdysis. As upon hatching, they are soft and whitish for some hours, and measure about 5 mm. in total length. By August 20, many were in the third instar and 7 to 8 mm. long. The color is now quite dark, with the pale tergal markings conspicuous. The development of the brood as a whole becomes less and less uniform so that we meet with larvæ of the same age but varying considerably in size. I lost count of the instars beyond the fourth, after which there must have been three or more ecdyses. Some of my second-year larvæ moulted in the laboratory during winter. It is certain that the insect requires the greater part of two years to reach the adult stage, and it is not improbable that in some cases a longer period is necessary. The full-grown larva is from about 16 to 18 mm. long, being nearly three times as long as wide. The head is subcylindrical and about one third as wide as the prothorax; the antennæ are three-jointed, the first joint being membranous, the second partly so, and the third with a terminal and subterminal sense-organ; the mandibles are much stouter and blunter than in *Photinus,* but like the latter they are arcuate and also notched below the apex. The body is much depressed, otherwise it is fusiform, being widest a little above the middle; the prothorax is the longest segment and shaped much as in the adult; the abdominal tergites are curved posteriorly, especially the caudal ones. The legs are rather spinose. The head is largely polished black, the mouth-parts brownish, the dorsal part of the body dull brownish, sometimes quite dark, and having subdorsal yellowish-white stripes of irregular nature disposed as follows: a large one from the anterior border of the prothorax, a smaller one from its posterior edge; these are more faintly repeated on the meso- and metathorax; on the abdomen there is a pair of more or less broken inbowed stripes, becoming obsolete posteriorly, and a similar blotch near the lateral edge of each tergite. The dorsum is more or less irregularly dotted, in deep punctations, with blackish, which serves to darken the color as a whole; blackish spots are grouped inside the pale abdominal lunules, and a more or less broad arcuate line cuts into the subdorsal markings from within. On the ventral surface the color is dirty yellowish white except for some latero-ventral blotches of brown, which however are absent on sternites seven and eight and a part of nine.

The legs are pale wood brown, darker apically. The body is quite rugose, with spines along the margins and on the legs.

Throughout the summer and fall, when the days are still warm, these peculiar testudiform larvæ can be taken in goodly numbers creeping over the ground, near edges of brooks, under brushwood, and even several inches up plant stems. Most of them prove to be larvæ in the second year of their growth. Specimens in the second, third and fourth moults are less commonly seen, but all shine brightly and steadily from two little yellowish-green points on the eighth abdominal sternite. When a light is brought near them they hasten away, and when touched on the back have a habit of flattening themselves.

The feeding habits of American lampyrids are more imperfectly known than those of Europe, where Fabre, Newport and others have studied the natural history of *Lampyris noctiluca.* As a larva, this insect feeds upon *Helix nemoralis, aspersa,* and probably other snails which it cautiously bites, injecting a poisonous deliquescing fluid into its prey at the same time. The mollusc is rendered inert by several of these tweaks and can then be devoured at leisure. Fabre (1913) speaks of the remarkable case of the Algerian beetle, *Drilus marocanus,* allid to the glow-worm, which fixes itself to the surface of the snail-shell and there awaits, for days if it needs be, for the snail to open up the strong lid with which it is provided. In America, *Phengodes* is known to feed upon myriopods, and *Pyractomena lucifera* lives in salt marsh meadows among snails. McDermott (1910), in speaking of the larva of *Photuris pennsylvanica,* says: "These larvæ appear to be semi-aquatic in habit; at this time of the year (early September), while walking along the edge of Rock Creek, in Rock Creek Park, Washington, D. C., numerous points of greenish light, which glow slowly and then die out slowly, to glow again in a moment or so, may be seen at the very edge of the water; on investigation these proved to be the larval forms of *Photuris* clinging to moist stones, weeds, etc., and presumably preying upon the smaller living things there." On the evening of September 8, 1913, I chanced upon three *Photuris* which were disposing of a large limp earthworm they had evidently overcome a few minutes before my arrival. This is the only occasion on which I saw *Photuris* larvæ feeding in the field. In the laboratory they readily devoured cut-up insects, which they left as mere shells. Certainly snails appear to be far too scarce in this vicinity to furnish even a little of the food. The larvæ would not touch living slugs in the laboratory, but earthworms, particularly those which had been wounded, were often attacked and eaten. A good-sized earthworm was placed in a jar with several larvæ. In the bright electric light but one was bold enough to affix itself to the hinder part of the worm, with its prothorax bent down towards its prey. It allowed the worm to pull it about, and let drag its expanded prolegs, chewing steadily and relentlessly the while. Apparently the worm suffered partial paralysis in the attacked region since it retaliated but feebly, except at the first few tweaks. In the morning the worm was found dead, with several larvæ feeding upon it. One end was quite eaten away, and here and there along its remaining length was a number of lumps which were evidently the result of bites. Another worm in the same dish remained uninjured. A decidedly large and vigorous worm, about four inches in length, was left over night in a battery jar half filled with earth and containing about thirty large larvæ. One end of the creature had been previously injured but the animal was nevertheless quite active. At 10 P. M., upon examining the jar after it had been kept in darkness for some time, it was found that the worm had been attacked and was being devoured at three different points, including the wounded end. I counted fifteen larvæ engaged at this repast. The worm was still capable of slow movement, and, if squeezed with a pair of forceps, of considerable activity. The next morning revealed a number of much distended larvæ, feeding on the remnants of their prey—two pieces, one a mere stub, the other a somewhat flaccid piece an inch and a quarter in length. It is quite probable that while earthworms form a good proportion of the food of *Photuris,* it must feed upon a diversity of other forms. The mandibles seem to be blunter and much stouter than those of most lampyrid larvæ so that the creature may devour what it can overcome. Not being provided with salivary glands, it must, like many other carnivorous beetle larvæ (Carabidæ, Dystiscidæ, etc.), inject an alimentary poison, probably secreted by the midgut, into its prey.

Unlike the more slender *Photinus,* the *Photuris* larva is hardly subterranean in its nocturnal habits and is doubtless a more extensive traveller. By the end of October, I could find but few larvæ in the field. The ones confined indoors were for the most part resting upon the floor or suspended from the roof of well-formed cells, under a thick strip of mossy soil, but owing to the indoor warmth, none of these larvæ was in a truly resting state. The abnormal laboratory conditions were probably responsible for the development of prothetely in two individuals (see Psyche, XXI, p. 126, 1914). Several pupated indoors, in February and March, but the majority transformed during May. Evidently the winter larval cells are not the pupal chambers, for these were largely deserted in the spring, when the insects took some food. On March 31, 1915, I found a few second-year *Photuris* larvæ hibernating under small stones, in earthen chambers. Situated as they are, from one to several inches below the surface of the ground, they successfully pass through the rigorous winters of New England.

A pupating larva rests quietly on its back, with the head quite extruded by the developing pupal head; the skin finally splits along the mid-dorsum and the pupa is disclosed. Pupating larvæ have a diffuse glow. But one pupa was found in the field, and the moist soil which I had slightly disturbed with my foot revealed this decidedly effulgent specimen. The pupa has an extended length of 11 mm. and an arcuate length of 9 mm. It is robust and somewhat less arcuate than *Photinus* pupæ, and has the hind legs free for a considerable distance. The head and appendages are translucent whitish, the abdomen is more opaque and with a slight creamy yellow tinge dorsally. This tinge extends up to and includes the metathorax, the yellow being divided by the line of the dorsal vessel. The insect is nowhere pinkish. The thin free edges of the first abdominal segments are somewhat drawn out laterally and dorsally and bear a loose tuft of brown hair; more such hair occurs at the end of the abdomen and especially along the edges of the prothorax and more sparsely along the posterior border of the abdominal segments. The pupa retains the two steady and strongly luminous points of the larvæ on the eighth abdominal segment, and, in addition, the head and the thorax are effulgent, so that it can be seen in the darkness for a distance of a dozen feet or more. At times the abdomen is faintly luminous, and when near emergence the adult light-organs also function. The pupal period is quite brief. The pupa is rather active, wriggling decidedly. The larval lights as well as the diffuse glow of the head and thorax disappear when the adult hatches, or shortly thereafter. I observed an adult female bred in the laboratory, and probably a day old, which on being brought into darkness, was found to have the adult as well as the larval light-organs shining steadily, and in addition, the vertex and frons of the head (where the chitin was transparent) shone also. The dorsum of the thorax down to the abdomen, in the more transparent portions, had an unmistakable glow. Such conditions however were not found in the field, nor upon dissecting older specimens. It is evident that a considerable time must elapse after it has hatched from the pupa before the insect is really firm and mature, when the photogenic granules are seen to glow only in the luminous organs of the adult.

But little was done on the internal anatomy of this insect. The larval digestive and nervous systems are practically the same as in *Lampyris noctiluca,* as figured by Vogel (1915). If we compare the nervous system of the larva and adult *Photuris,* the following points will be noted: the larva has a total of thirteen distinct ganglia in the nervous system, the adult twelve; in the former the brain is in the cervical region, behind the head, and the last two abdominal ganglia, the seventh and eighth, the latter being compound, are separated by a distinct though comparatively short pair of connectives; in the adult the brain, of course, lies within the head and is more closely connected with the subœsophageal ganglion, the first abdominal is very near to, though distinct from the third thoracic ganglion and the seventh and eighth are fused into one oblong ganglion with a median constriction. Thus it is seen that there is no considerable difference between these generalized systems in the larva and adult.

RESUMÉ.

1. Biological studies were made on six different species of fireflies in New England, viz., *Photinus consanguineus,* and *scintillans, Ellychnia corrusca, Lucidota atra, Pyratomena* sp. and *Photuris pennsylvanica.*
2. Of these, *Photuris pennsylvanica* is the most brilliant and *Ellychnia corrusca* the faintest in luminescence in the adult stage.
3. In the case of *Photuris* and *Photinus* at least, the larval light organ is different from that of the adult one which replaces it at maturity.
4. The light organ of the adult is probably used chiefly for the

bringing together of the male and female, is more brilliant in one than in the other sex and is readily controlled.

5. The adult female of *Photuris* is carnivorous and very voracious and even cannibalistic. The other genera seem to be herbivorous as adults.

6. Ova were obtained from all but *Pyractomena*. They are subspherical and at first sticky and less than 1 mm. long. They are deposited a short distance in soil, moss, etc. That of *Photuris* has a yellowish tinge, the remaining five are dull whitish. All are for a time at least faintly luminous.

7. The larvæ of *Photinus, Ellychnia* and *Lucidota* are elongate and somewhat depressed and more or less pinkish ventrally—those of *Pyractomena* and *Photuris* are wider, flattened fusiform, and the latter is nowhere pink. The larvæ of *Photinus* and *Lucidota* are very largely subterranean, but *Pyractomena* is probably in part arboreal while the largely terrestrial *Photuris* frequently ascends weeds.

8. The larvæ are probably all carnivorous and *Photuris* devours earthworms with avidity.

9. The larvæ are all luminous—two points on the eighth abdominal sternite furnish the rather slowly controlled luminescence.

10. The larval life, perhaps with the exception of *Ellychnia corrusca,* extends in most cases over the greater part of two years.

11. *Ellychnia corrusca* hibernates as an adult beneath moss, logs, etc., the rest hibernate as larvæ.

12. The pupæ are luminous. The pupa of *Pyractomena* is pigmented and suspended like that of a Coccinellid, the others are pallid and formed beneath the ground. This stage is brief.

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THE GROWTH OF INSECT BLOOD CELLS IN VITRO.[1]

BY R. W. GLASER.

In order to obtain an insight into various pathological changes taking place in diseased insect tissue, I undertook a series of experiments dealing with the cultivation of such tissue in vitro. The degenerative changes occurring in normal and in pathological blood cells were especially studied for the reason that the blood is frequently used in diagnosing the health of a particular insect. In the polyhedral diseases of insects a general picture of the progress during the later stages of the disease can be obtained by examination of the blood. This type of disease is recognized by the fact that nucleoprotein reaction bodies, termed polyhedra, are formed within the nuclei of the blood and certain other tissue cells. It was also of considerable interest to ascertain whether slides with growing insect tissue could be infected with the polyhedral disease virus and whether polyhedra would form within the nuclei of cells thus infected. By way of comparison, it was also of interest to see through what changes normal cells pass when permitted to degenerate naturally.

Incidentally, a number of observations were made in regard to the morphology and behavior of growing insect blood cells and I will present the observations in the hope of stimulating work along these lines. Although the cultivation of insect tissue is not new, this method of studying various embryological, morphological, and physiological questions pertaining to entomology has been almost entirely neglected and I am convinced that the cultivation of tissues will greatly simplify the solution to many difficult problems.

Goldschmidt in 1915, by means of the tissue culture method, studied the spermatogenesis of *Samia cecropia* L. Spermatogonia or young spermatocytes were kept alive for about three weeks, and the follicle membrane for some weeks more. This piece of work and that of Lewis and Robertson, 1916, on the male germ cells of *Chorthippus curtipennis* Scudd (*Stenobothrus curtipennis* Harris) seem to be the only examples of insect tissue cultivation found in the literature.

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[1] Contribution from the Entomological Laboratory of the Bussey Institution in coöperation with the U. S. Bureau of Entomology. (Bussey Institution No. 125.)

For the experiments here described the larvæ of *Malacosoma americanum*, *Cirphis unipuncta*, *Laphygma frugiperda* and *Porthetria dispar* were used. My method did not differ materially from those of Harrison, Carrel, Goldschmidt, etc. However, since most of my experiments dealt with the cultivation of insect blood I will briefly outline the method of procedure. The larvæ to be operated upon are held upside down in one hand and the anterior and posterior halves bent back. A proleg is then thoroughly washed with 80 to 95 per cent. alcohol after which it is clipped with very fine aseptic scissors. The drop of blood which oozes out is caught on a sterile cover slip which is then placed on a sterile depression slide and the edges sealed up with sterile vaseline. A great many slides were prepared in this manner, *i.e.*, the blood corpuscles were simply mounted in their own plasma. In other cases Locke's solution,[1] or a mixture of Locke's solution and plasma was found satisfactory. In general Locke's solution is isotonic with insect tissue and can be very freely used for cultivation and for the washing out of old cultures in order to free them of harmful by-products. Locke's solution has no particular advantage over the plasma, except that the preparations are a bit more transparent, owing to the fact that large amounts of fibrin have been eliminated.

Blood was obtained from healthy *Malacosoma americanum* larvæ and six slides prepared. In a few days some of the blood cells disintegrated, but the majority lived and multiplied. In ten days beautiful syncytia had formed (Pl. I, fig. 1). At the end of this time three of the slides were inoculated with some polyhedral material which had been passed through Berkefeld Grade "N" candles. The other three slides were kept as checks. All slides were observed for forty days. After this the cells in both experiments and checks ceased growing and disintegrated normally.

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[1] Locke's solution consists of NaCl 0.9 per cent., $CaCl_2$ 0.025 per cent., KCl 0.042 per cent., $NaHCO_3$ 0.02 per cent., Dextrose 0.25 per cent., Peptone 0.2 per cent.

The inoculated slides showed no indications of the formation of polyhedral bodies within the nuclei of the blood cells. This experiment was repeated twice more and with the same result; no difference between the experiments and checks was observed.

Twelve healthy *M. americanum* larvæ were fed with polyhedral virus passed through Berkefeld Grade "N" filters. As checks the same number of larvæ were infected with the virus sterilized by autoclaving. At the end of ten days tissue culture preparations were made with blood taken from the experimental animals and from the checks. The slides were studied at once and it was found that two thirds of them, representing blood taken from animals fed with the unsterilized virus, showed infection. The early stages of polyhedra were discernible within the nuclei of many of the blood cells. Other cells still seemed to be in a normal condition. The slides representing blood taken from the checks appeared perfectly normal. The next day all of the slides were again examined, but no change was noticed with the exception that some of the cells had divided. In one day more nearly all of the experimental blood cell nuclei were beset with large and small polyhedra. In six to seven days the blood cells from the experimental animals began to disintegrate with the liberation of small and large, well formed, typical polyhedra. The cells on the check slides disintegrated normally five days later.

A large number of the blood cells of *M. americanum* are of the mulberry corpuscle type (Pl. I, fig. 2). These are not so well adapted to cultivation as the ordinary blood cells (Pl. I, figs. 3 and 4). For this reason the experiments were repeated with the blood of *Porthetria dispar* in which the mulberry cells are in the minority. In these experiments it was likewise impossible to infect growing blood cells with the polyhedral virus, but if animals were first infected the formation of the polyhedra could be traced very nicely by taking the blood from the infected animals in about ten or twelve days and studying by means of the tissue culture method.

What do these experiments signify? Several possibilities at once suggest themselves, but I will merely outline the two most probable. First of all let us suppose that I have actually cultivated the polyhedral virus on the tissue culture slides. Then why is it impossible to infect such tissue directly with the virus? Why is it necessary to give the virus "a start" within the insect itself? Perhaps the early stages of the virus require some particular organ or tissue or some particular condition. The insect itself fulfills the required condition, but the blood cells growing in vitro do not. The later stages of the virus, however, find the conditions suitable on the tissue culture slides.

Then again I may not have cultivated the virus at all. The caterpillars were infected with the polyhedral virus which may have a strong affinity for some particular tissue other than the blood. Toxins may be elaborated and getting into the blood may start the degenerative changes which culminate in the formation of polyhedral bodies. These degenerative changes, after beginning within the animal, may later proceed outside of it on the tissue culture slides in the absence of the virus. I think that a series of passage infections would clear up the whole matter. This I have not yet attempted. A series of animals should be infected with fresh virus. In ten or twelve days tissue culture slides should be prepared from the blood. When polyhedral bodies begin to form, another series of animals should be infected from the slides. In ten or twelve days the blood should be taken from these animals and kept on slides and if polyhedra form, a fresh series of animals should be again infected and so on. Such a series must, of course, be accompanied by suitable checks. If the animals in the later experimental series die typically and if there is no increase in the period from infection to death (about twenty days) it would be fairly certain that the virus has been cultivated and that one is not dealing with a partial recovery of the amount of the virus originally used.

In cultivating insect tissue it is always well to prepare a great many slides. A few become contaminated with bacteria, but many disintegrate normally without showing the least inclination towards growth. The ability of the tissue to grow well also seems to a slight degree to vary according to the species of insect. The tent-caterpillar blood, for instance, does not grow as readily as the blood taken from the true army or fall-army worm. The blood from these two species does not grow nearly so well as the blood of the gipsy-moth caterpillar. One should never discard slides for at least a week or more. Very frequently nearly all of the cells will disintegrate during the first five or six days. A few, however, live and these later increase and multiply forming beautiful syncytia. I have frequently given up slides as hopeless on account of what seemed to me to be complete disintegration, yet on reëxamination in about two weeks, I was astonished to find clusters of healthy looking, growing cells.

I have kept true army and fall-army worm blood preparations alive for one month without washing out the cultures or transferring them to a fresh medium. Gipsy-moth blood cultures have been kept alive for as long as seventeen weeks without washing or transferring. It is true, the cells were no longer vigorous and showed signs of beginning degeneracy, but they were alive. After washing out these old cultures with sterile Locke's solution and filter paper, as is usually done, and transferring to a fresh medium like Locke's solution the cells grew and multiplied as before.

In so far as the morphological elements contained in insect blood are concerned, the ordinary amœbocytes (Pl. I, figs. 3 and 4) are the only ones which multiply in tissue cultures. The minute amœbocytes (Pl. I, fig. 5), the mulberry corpuscles (Pl. I, fig. 2), and the cytoplasmic free cells (Pl. I, fig. 6) described by me in 1915[1] always disintegrate. A difference of opinion seems to exist in the literature as to the origin of the blood corpuscles of larval and adult insects. From my studies it appears that the blood cells, after their differentiation from the mesoderm during embryological development, simply maintain their numerical equilibrium in larvæ and adults by dividing mitotically at certain intervals. I cannot find any so-called blood corpuscle forming tissue at least in sections of caterpillars.

Some of the visible changes observed on the culture slides in normal degenerating blood cells have proved instructive and have further helped to strengthen my views (published elsewhere) in regard to the nature of the polyhedral bodies found in the nuclei of certain pathological cells. Normal disintegration of insect blood cells is always accompanied by the formation of protein crystals within their cytoplasm. Crystalline disintegration accompanied by granular disintegration seems to be the rule in normal disintegrating insect tissue. Granular disintegration alone seems to be exceptional in blood cells at least. In the polyhedral diseases of insects protein crystals are likewise formed within the degenerating cells, but here the crystals are formed within the nuclei instead of within the cytoplasm.

---

[1] Wilt of gipsy-moth caterpillars. Journal of Agricultural Research. Vol. IV, No. 2, May, 1915, p. 113.

Normal blood cells in the early stages of disintegration show distinct granulations and also small highly refractive greenish crystals within the cytoplasm (Pl. I, fig. 7). The nucleus does not show any changes till rather late. In a few days the cytoplasmic crystals become more and more numerous and likewise grow in size (Pl. I, fig. 8). Still later they reach the size of 5 and 6μ and assume a shape very closely simulating polyhedra. In a few days more the cells disintegrate, completely liberating granules and crystals (Pl. I, fig. 9). Some of these liberated crystals measure 15μ or more in diameter (Pl. I, fig. 10). Millon's reagent demonstrates their protein nature and I believe that they are similar in many ways to the polyhedra. Of course, the composition of the polyhedra is different, since they are formed within the nuclei under pathological conditions, but what I wish to emphasize is that insect tissue has a normal tendency towards crystalline disintegration. Is it, therefore, so surprising to find crystals (polyhedra) within the degenerating nuclei in a series of insect diseases?

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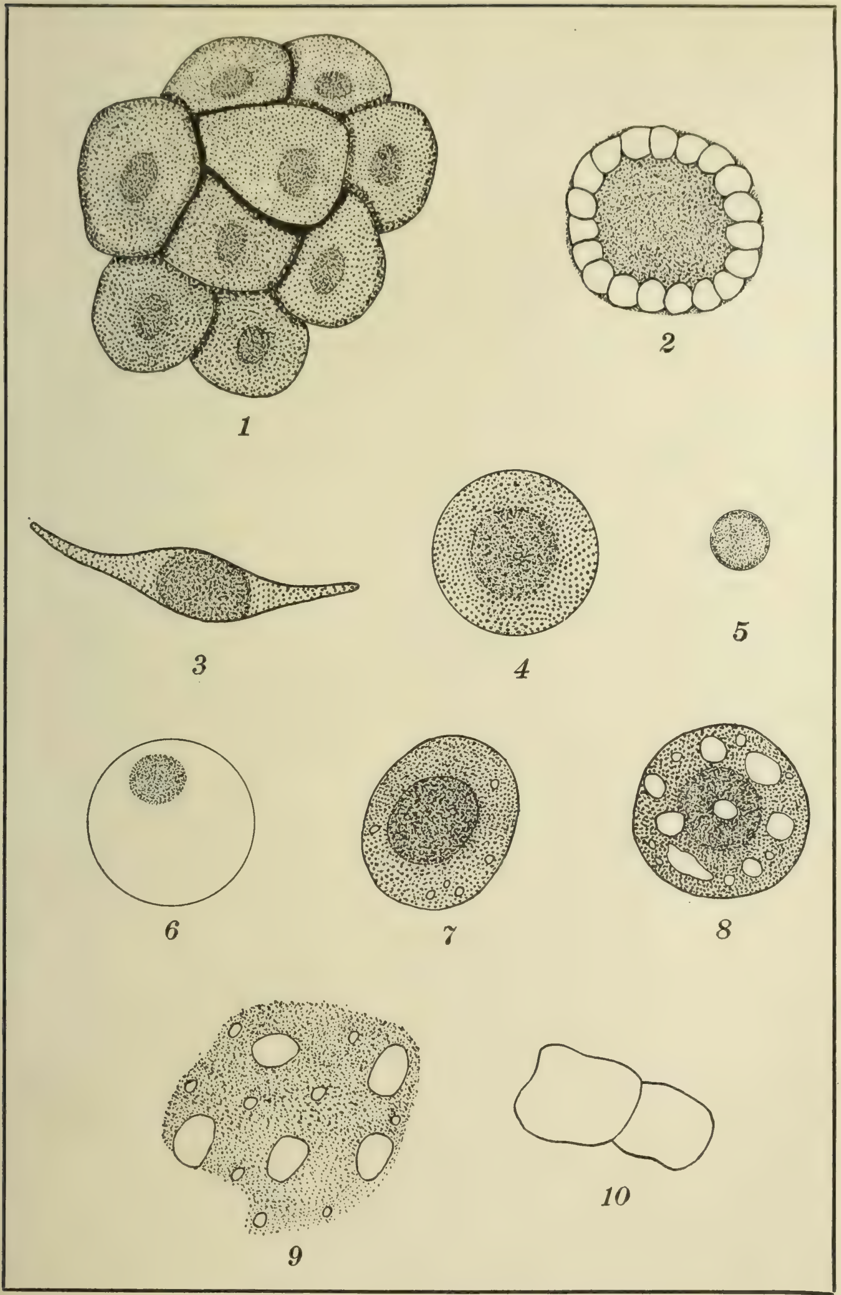

GLASER—*Growth of Insect Blood Cells in Vitro.*

EXPLANATION OF PLATE.

Fig. 1. Syncytium of growing amœbocytes.

Fig. 2. A type of mulberry corpuscle.

Fig. 3. Amœboid amœbocyte.

Fig. 4. Round amœbocyte.

Fig. 5. Minute amœbocyte.

Fig. 6. Cytoplasmic free cell.

Fig. 7. Degenerating amœbocyte with a few small, refractive crystals in cytoplasm.

Fig. 8. Degenerating amœboycte with numerous large, refractive crystals in cytoplasm.

Fig. 9. Disintegrated amœbocyte showing liberated granules and crystals.

Fig. 10. Double crystal formed by a normally disintegrating amœbocyte.

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THE ANTS OF ALASKA.

By William Morton Wheeler.

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Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905, Lieutenant Commander L. M. Garrett, U. S. N., Commanding, published or in preparation: —

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H. B. BIGELOW. XVI.[16] The Medusae.
H. B. BIGELOW. XXIII.[23] The Siphonophores.
H. B. BIGELOW. XXVI.[26] The Ctenophores.
R. P. BIGELOW. The Stomatopods.
O. CARLGREN. The Actinaria.
R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
H. L. CLARK. The Starfishes.
H. L. CLARK. The Ophiurans.
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L. J. COLE. XIX.[19] The Pycnogonida.
W. H. DALL. XIV.[14] The Mollusks.
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W. E. RITTER. IV.[4] The Tunicates.
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G. O. SARS. The Copepods.
F. E. SCHULZE. XI.[11] The Xenophyophoras.
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E. C. STARKS. XIII.[13] Atelaxia.
TH. STUDER. The Alcyonaria.
JH. THIELE. XV.[15] Bathysciadium.
T. W. VAUGHAN. VI.[6] The Corals.
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No. 2.— *The Ants of Alaska.*

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION, HARVARD UNIVERSITY, NO. 126.

By William Morton Wheeler.

Our knowledge of the Formicidae of Alaska has been of very slow growth, probably because most of the collectors who have ventured into that extensive region have found ants too scarce and inconspicuous to merit serious attention. In 1899 Prof. Trevor Kincaid, while accompanying the Harriman Alaska Expedition, secured a number of specimens of five species which were recorded by Pergande (Proc. Wash. acad. sci., 1900, **2**, p. 519–521) as *Formica neorufibarbis* Emery, *Lasius niger* Linné subsp. *sitkaensis* Pergande, *Leptothorax yankee* Emery var. *kincaidi* Pergande, *Myrmica sabuleti* Meinert var. *lobifrons* Pergande and *Myrmica sulcinodoides* Emery. Three of these were new to science, but unfortunately Pergande's descriptions of them are inadequate and puzzling, and although the types (No. 5277–5279) were cited as being in the U. S. N. M., Mr. S. A. Rohwer, after careful search has been unable to find them, and I have failed to find any cotypes in Pergande's private collection, which was acquired by the Museum after his death. Within recent years I have recorded *Myrmica brevinodis* Emery var. *alaskensis* Wheeler, *Formica fusca* Linné var. *gelida* Wheeler and *Camponotus herculeanus* Linné var. *whymperi* Forel from Alaska. During the summer of 1916 Mr. J. A. Kusche of Eldridge, California, kindly collected a considerable number of ants for me in several Alaskan localities and in the adjacent Yukon territory of British America. Among the material I find three forms not hitherto recorded from these regions, so that the total known to date is twelve. They represent, however, only seven species: *Myrmica brevinodis, M. scabrinodis, Leptothorax acervorum, Lasius niger, Formica sanguinea, F. fusca,* and *Camponotus herculeanus,* all well-known from the boreal portions of Europe and Asia, except *Myrmica brevinodis,* which might, in fact, be regarded as a subspecies of the Eurasian *M. sulcinodis.* Four of the varieties seem to be peculiar to Alaska, but all the other forms range widely through British America and southward into the United States along the higher slopes of the Sierra-Cascade and Rocky Mountains. The specimens collected by

Mr. Kusche at Fort Yukon, Nulato, and Rampart (64°–67° N. L.) are of unusual interest, because, with the single exception of the specimens of *Leptothorax kincaidi* taken by Mr. F. H. Whitney on the Upper Kugarok River, near Nome, and recorded in my paper on the mountain ants of western North America (Proc. Amer. acad. sci., 1917, **52**, p. 512), no American ants had previously been found so far north. Fort Yukon, the remotest of the localities, is, in fact, situated on the Arctic Circle, which, I believe, may safely be taken as the extreme northern limit of our ant fauna. Owing to the important bearing of all the elements of the Alaskan biota on questions of geographical distribution and on the question of a former Alaskan-Siberian land-bridge in particular, it seems advisable to publish a brief annotated list of the known Alaskan Formicidae together with a record of the various localities in which they were collected.

1. MYRMICA BREVINODIS Emery var. SULCINODOIDES Emery.

Pergande records this form from Sitka and says that the palest specimens in his series agreed exactly with those he saw from Hill City, South Dakota. The specimen from Homer, Alaska (A. Mehner) referred by me to the var. *frigida* Forel (Bull. Wisc. nat. hist. soc., 1907, **5**, p. 78) may be more properly referred to *sulcinodoides*. Indeed, I doubt whether *frigida* can be maintained as a distinct variety. Forel's var. *whymperi* is also, in my opinion, a synonym of *sulcinodoides* Emery. The latter is known from higher elevations, up to 11,000 feet, in the Rockies of British Columbia, Utah, Colorado, and New Mexico and in the Sierra Nevada. In the paper cited above I called attention to the peculiar greenish yellow color of the larvae of this ant and their oily luster.

2. MYRMICA BREVINODIS var. ALASKENSIS Wheeler.

Recently described from workers taken at Seward, on the Kenai Peninsula by Mr. F. H. Whitney (Proc. Amer. acad. sci., 1917, **52**, p. 503). Numerous specimens from two colonies found by Mr. Kusche at Fort Yukon and in the Pynaw Mts., near Rampart, also belong to this variety.

3. MYRMICA BREVINODIS var. KUSCHEI, var. nov.

Worker. Length 3–3.5 mm.

Very similar in sculpture, pilosity, and color to the var. *alaskensis* but averaging somewhat smaller, with shorter and straight, instead of curved, epinotal spines, the antennal scapes very distinctly broader and flatter at the base and with the middorsal portion of the postpetiole smooth and shining. The clypeus has only about eight coarse longitudinal rugae as in *alaskensis.*

Female (deälated). Length 5.5 mm.

Much darker than the worker, the head, thorax, petiole, postpetiole, and gaster being castaneous, the mandibles, antennae, and legs brownish yellow. Rugae on the body coarse, those on the pronotum very coarse and vermiculate, on the remainder of the thorax longitudinal, finer on the pleurae than on the mesonotum and scutellum. Postpetiole above without a smooth area, sharply, regularly, and concentrically rugose, the rugae transverse at the posterior border. Surface of body distinctly more shining than in the worker; pilosity very similar.

Described from a female and twenty-three workers taken by Mr. Kusche from a single colony at Ketchikan.

The worker and female of this variety are readily distinguished from the corresponding phases of the other described forms of *brevinodis* by the peculiar sculpture of the dorsal surface of the postpetiole, the sculpture in the worker recalling that of *Myrmica scabrinodis* var. *detritinodis* Emery, while the postpetiolar rugae in the females of the other forms are not regular and concentric but longitudinal and irregular or interrupted.

4. MYRMICA SCABRINODIS Nylander subsp. LOBICORNIS Nyl. var. LOBIFRONS Pergande.

Pergande described this form as *M. sabuleti* var. *lobifrons* but his description is so brief as to apply to almost any small Myrmica. He says merely that it measures 3 mm. and is dark brown or black, with the "mandibles, antennae, legs, sides of the thorax and of the abdomen more or less distinctly yellowish brown, reddish brown or almost black," and adds that it is "closely related to a form of *Myrmica sabuleti* inhabiting South Dakota, but is somewhat larger and much darker, with the sculpturing of the head and thorax coarser and the hairs stouter and shorter." He cites no locality for the types (No. 5279, U. S. N. M.), which seem to be lost. As *sabuleti* is itself now regarded as merely a variety of *scabrinodis*, it is clear that *lobifrons* must be referred to some other form. I conjecture that it is a variety of *lobicornis*, which I have recently shown (Proc. Amer. acad. sci., 1917, **52**, p. 504) to be actually represented in America by Forel's var. *glacialis* of the Rocky Mts. and Sierra Nevada. Perhaps *glacialis* is merely a synonym of *lobifrons*, but this can be determined only if Pergande's types are found or by further collecting in Alaska.

5. Leptothorax acervorum Nylander subsp. canadensis Provancher var. kincaidi Pergande.

This variety was described as *L. yankee* Emery var. *kincaidi* from a female and twelve workers taken by Professor Kincaid at Metlakahtla. I have recorded it from the Upper Kugarok River, near Nome (65° N. L.) where it was taken by Mr. F. H. Whitney. Numerous workers taken by Mr. Kusche at Skagway and White Pass agree even more closely with Pergande's description, as they are somewhat smaller and lack the crescentic black spot on the pronotum. Perhaps the more northern specimens should be regarded as a distinct variety.

6. Lasius niger Linné var. sitkaënsis Pergande.

This form, not represented among the specimens collected by Mr. Kusche, was described by Pergande as a subspecies of *L. niger* from twenty-five workers taken at Sitka. As stated in my recent paper on the mountain ants, I believe it to be identical with a form which I have found to be common throughout the Canadian zone. Pergande mentions its similarity to *Lasius subniger* of Maine (*recte neoniger* Emery). If I am right in my identification of the Alaskan form it is merely a variety and not a subspecies of the typical Eurasian *niger*.

7. Formica sanguinea Latreille subsp. subnuda Emery.

Mr. Kusche secured many workers of this subspecies from several colonies at Skagway and White Pass, Alaska and White Horse, Yukon.

All agree with the typical form of the subspecies from the Canadian zone of southern British America and the United States in lacking erect hairs on the thorax and in having only a very few inconspicuous hairs on the dorsal surface of the head. The slaves in several of the colonies were workers of *F. fusca* var. *gelida* and var. *neorufibarbis*. Some of the colonies contained a few small *subnuda* pseudogynes. If Wasmann's and Muckermann's contention is correct, that pseudogynes are produced only as the result of the presence of staphylinid beetles of the tribe Lomechusini (species of *Xenodusa* in North America) in the *sanguinea* nests, we must suppose that these beetles range as far north as Alaska. This has not been demonstrated, so that my suggestion that pseudogynes may also be produced by other causes, is still worthy of consideration, especially as Mr. Horace Donisthorpe writes me that he is also of the opinion that pseudogynes occasionally make their appearance in British *sanguinea* colonies which have never been infested by lomechusine parasites.

8. Formica fusca Linné.

A number of workers taken by Mr. Kusche at Fort Yukon belong to the typical black form of this species, which is widely distributed, not only in the Canadian zone of North America, as I have shown in previous articles (Bull. M. C. Z., 1913, **53**, p. 496; Proc. Amer. acad. sci., 1917, **52**, p. 545) but also throughout boreal Eurasia as far north as latitude 65°.

9. Formica fusca var. marcida Wheeler.

I refer to this variety a deälated female and thirty-six workers taken by Mr. Kusche from a single colony at White Horse, Yukon, and a series of workers which he took at Fort Yukon, Alaska. The former are fully as large as the typical *fusca* and have the mandibles, antennae, and legs of an even paler and purer brownish yellow color than in the types which were taken in the Selkirk Mts. of British Columbia, the latter are much more like the types in size and color. This variety has also been taken in Alberta, Manitoba, Washington, and California but always in an alpine environment.

10. Formica fusca var. neorufibarbis Emery.

Under the name *F. neorufibarbis* Pergande included both this and the following variety. I believe that only his specimens from Metlakahtla, which he calls the palest form, belong to *neorufibarbis*, those from Sitka and Kadiak being referable to the var. *gelida*. Mr. Kusche secured several series of workers at Skagway and Ketchikan, Alaska and White Horse, Yukon. The large individuals have the thorax, petiole, and legs uniformly red, without traces of infuscation and are exactly like those taken by myself during the summer of 1915 in the Canadian Rockies and the Sierra Nevada.

11. Formica fusca var. gelida Wheeler.

The study of a long series of workers and deälated females taken by Mr. Kusche at Skagway, Nulato, Ketchikan, and in the Pynaw Mts., near Rampart, Alaska, and at White Horse, Yukon, and of a few workers from Seward (F. H. Whitney) and Kasiloff Lake, on the Kenai Peninsula, shows that this variety cannot be satisfactorily distinguished from *neorufibarbis* except by the color of the larger workers, which in *gelida* have the legs and thorax more or less and often deeply infuscated. Darker specimens seem to pass over into the typical *fusca*, while immature specimens are difficult to distinguish from the var. *marcida*.

12. Camponotus herculeanus Linné var. whymperi Forel.

This variety is not only widely distributed through the Canadian and Hudsonian zones of North America, but is said to occur also in Siberia. Mr. Kusche obtained numerous worker and female specimens from several colonies at Fort Yukon, Skagway, and Nulato, Alaska and White Horse, Yukon. I have also seen specimens from Kasiloff Lake, on the Kenai Peninsula (Berlin Museum) and Koyukuk (W. J. Peters). The variety differs from the typical *herculeanus* merely in the slightly longer and more abundant, subappressed hairs on the tibiae. As I find this character to be inconstant on comparison of American and European specimens, *whymperi* would seem to be an insignificant if not a spurious variety.

Postscript.—Just after correcting the first proof of this paper Mr. S. A. Rohwer informed me that he had succeeded in finding in the U. S. N. M. the types of the varieties of ants described by Pergande from Alaska and that he was sending me paratypes of *Lasius sitkaënsis, Myrmica lobifrons,* and *Leptothorax kincaidi* and a couple of workers identified by Pergande as belonging to *Myrmica sulcinodoides.* The conclusions I have reached from a study of the specimens may be briefly stated:—

(1). *Myrmica brevinodis* var. *sulcinodoides* Emery.— The specimens from Sitka referred by Pergande to this variety differ somewhat in color from the form I regard as typical *sulcinodoides,* as they have the head and gaster dark brown, instead of black, and the remainder of the body and appendages yellowish brown instead of deep red. I should be inclined to refer them to the var. *subalpina* Wheeler, but as Pergande refers to differences of color in his series, the specimens before me may be somewhat immature.

(4). *Myrmica scabrinodis* subsp. *lobicornis* var. *lobifrons* Pergande.— The types and paratypes are from Metlakahtla and the two of the latter received from Mr. Rohwer belong to different species which were not distinguished by Pergande. One is identical with *M. scabrinodis lobicornis* var. *glacialis* Forel as I find by comparison with a cotype from Vermillion Pass, Alberta, received from Professor Forel many years ago. The var. *glacialis* Forel therefore becomes a synonym of *lobifrons* Pergande. The other specimen belongs to *Myrmica brevinodis* and agrees perfectly with the cotypes of the var. *kuschei* described above. That Pergande really based his variety on a specimen with the antennal scape toothed at the base, is shown by his attaching the form to *Myrmica sabuleti.*

(5). *Leptothorax acervorum* subsp. *canadensis* var. *kincaidi* Pergande. Two worker paratypes from Metlakahtla agree closely with the specimens recorded above from Skagway and White Pass in size, form, and sculpture, but the latter have the light portions of the body and appendages paler and more reddish and there are no traces of infuscation on the thoracic dorsum and the summits of the petiolar and postpetiolar nodes. The Pergande specimens also have the legs without the short, erect or suberect hairs which are clearly visible in the specimens taken by Mr. Kusche. The latter, therefore, are more like the typical *canadensis.*

(6). *Lasius niger* var. *sitkaënsis* Pergande.— The interpretation of this variety given in my recent paper, "The mountain ants of western North America" (Proc. Amer. acad. sci. 1917, **52**, p. 524), is shown by a study of two paratypes to be correct. The paratypes are somewhat larger and darker than most of the specimens in my collection from boreal portions of the United States and British America, but series from Flathead Lake, Montana and Pullman, Washington are almost identical in size and coloration with the paratypes from Sitka. Smaller and darker specimens grade into the var. *neoniger* Emery.

The following Publications of the Museum of Comparative Zoölogy are in preparation:—

LOUIS CABOT. Immature State of the Odonata, Part IV.
E. L. MARK. Studies on Lepidosteus, continued.
E. L. MARK. On Arachnactis.
H. L. CLARK. The "Albatross" Hawaiian Echini.

Reports on the Results of Dredging Operations in 1877, 1878, 1879, and 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," as follows: —

A. MILNE EDWARDS and E. L. BOUVIER. The Crustacea of the "Blake."
A. E. VERRILL. The Alcyonaria of the "Blake."

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieutenant Commander Z. L. Tanner, U. S. N., Commanding, in charge of Alexander Agassiz, as follows:—

K. BRANDT. The Sagittae.
K. BRANDT. The Thalassicolae.
O. CARLGREN. The Actinarians.
R. V. CHAMBERLIN. The Annelids.
W. R. COE. The Nemerteans.
REINHARD DOHRN. The Eyes of Deep-Sea Crustacea.
H. J. HANSEN. The Cirripeds.
H. J. HANSEN. The Schizopods.
HAROLD HEATH. Solenogaster.
W. A. HERDMAN. The Ascidians.
S. J. HICKSON. The Antipathids.
E. L. MARK. Branchiocerianthus.
JOHN MURRAY. The Bottom Specimens.
P. SCHIEMENZ. The Pteropods and Heteropods.
THEO. STUDER. The Alcyonarians.
—— The Salpidae and Doliolidae.
H. B. WARD. The Sipunculids.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding, as follows: —

R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
H. L. CLARK. The Ophiurans.
—— The Volcanic Rocks.
—— The Coralliferous Limestones.
S. HENSHAW. The Insects.
G. W. MÜLLER. The Ostracods.
MARY J. RATHBUN. The Crustacea Decapoda.
G. O. SARS. The Copepods.
L. STEJNEGER. The Reptiles.
C. H. TOWNSEND. The Mammals, Birds, and Fishes.
T. W. VAUGHAN. The Corals, Recent and Fossil.

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE.

There have been published of the BULLETIN Vols. I. to LIV. and Vols. LVIII. to LX.; of the MEMOIRS, Vols. I. to XXXIV., and also Vols. XXXVI. to XXXVIII., XL. to XLII., and XLIV.

Vols. LV., LVII., LXI. and LXII. of the BULLETIN, and Vols. XXXV., XXXIX., XLIII., XLV. to XLIX. of the MEMOIRS, are now in course of publication.

The BULLETIN and MEMOIRS are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by students and others in the different Laboratories of Natural History, and of work by specialists based upon the Museum Collections and Explorations.

The following publications are in preparation:—

Reports on the Results of Dredging Operations from 1877 to 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," Lieut. Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., Commanding.

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieut. Commander Z. L. Tanner, U. S. N., Commanding, in charge of Alexander Agassiz.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding.

Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from October, 1904, to April, 1905, Lieut. Commander L. M. Garrett, U. S. N., Commanding.

Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

Contributions from the Geological Laboratory, Professor R. A. Daly, in charge.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Mass.

[Reprinted from PSYCHE, Vol. XXIV, No. 1]

NOTES ON NORTH AMERICAN TINGIDÆ (HEMIPTERA).[1]

BY H. M. PARSHLEY.

A number of highly interesting forms of the Hemipterous family Tingidæ have recently been submitted to me for study by Mr. Nathan Banks of the Museum of Comparative Zoölogy and others mentioned below. In treating this material it has been necessary to take into account the recent publications of Osborn and Drake,[2] in which there is much requiring comment, as hereafter noted in part. Most of the conclusions were reached by a study of the papers cited in the light of Tingid material in my hands, and they have been verified by an examination of the type specimens concerned, through the courtesy of Professor Osborn.

The eminent European Hemipterist Bergroth has recently remarked on several occasions that the modern system of specific type fixation is likely to promote inadequate describing, and although many will not be able to approve his resultant refusal to designate definite type specimens, the force of his remarks must yet be strongly felt when it becomes necessary to deal with descriptions which are not only inadequate but even seem, in some particulars at least, to have been based upon a study of highly inaccurate figures rather than specimens—work which without some revision puts serious obstacles in the way of later investigators. Of course the designation of type specimens is not entirely to blame for this, but the feeling that species, however inadequately characterized, and genera, even without any description, are firmly established if only types are designated, tends to belittle the importance of the written record. After all, the printed word, capable of indefinite reduplication, accessible to everyone, and permanent, is of prime importance; while type specimens, limited in number, generally inaccessible, and perishable in nature, should be treated as of merely supplementary value. For this reason I am in accord with Van Duzee and others who maintain that where description and type disagree in important particulars, the former should take precedence.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 127.

[2] The Tingitoidea of Ohio, Ohio Biol. Surv., Vol. 2, Bull. 8, 1916, pp. 217–251.
Some New Species of Nearctic Tingidæ, Ohio Jour. Sci., Vol. 17, 1916, pp. 9–15.

Acalypta lillanis Bueno.

In their first paper Osborn and Drake properly treat the long- and short-winged forms as conspecific, but the drawing on page 221 is very inaccurate as regards the structure of the head, which, of course, is precisely similar in the two forms of the species. The differences in head and antennal structure to be noted in comparing this figure with that on the next page do not exist in nature. This is no doubt due in part to the fact that the artist, being unfamiliar with the subject, drew the two specimens from somewhat different points of view. The authors are then entirely unjustified in announcing, on page 9 of their second paper, that de la Torre Bueno's species is composite, the more so as they have not studied his extensive type series which I can state, after careful examination, to be perfectly homogeneous, as is a good series of the species in Mr. H. G. Barber's collection. Moreover, there is nothing in the original description[1] on which the assumption can be based, and it thus appears that as in some other cases undue attention has been given drawings of doubtful accuracy. Whether or not the type specimen of *A. ovata* O. & D. represents a species distinct from *lillianis* is another question. It is a little broader posteriorly than is usual in the short-winged form of the latter species and the first antennal segment is slightly different in form, but it agrees with the figure little better and presents no characters that I would consider of specific importance.

Fenestrella O. & D.

In their description of this extraordinary genus the founders omit to mention the following important characters: the bucculæ are contiguous anteriorly, much as in *Melanorhopala*, for instance; the metasternal orifices are obsolete; the surface of the hemielytra is deeply channelled, the main veins being raised on very prominent roof-like elevations, a condition which would be somewhat modified in the as yet unknown long-winged form. The drawing of the type species on page 223 of the first paper is inaccurate in numerous particulars: the general form is in reality much less elongate, the

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[1] Bull. Brooklyn Ent. Soc., Vol. 11, 1916, p. 39.

costal margin being more abruptly curved posteriorly than the figure would indicate; the base of the third antennal segment is slightly capitate; the eyes project laterally less than one third their width beyond the antenniferous tubercles, etc. *Fenestrella* is extremely isolated, having no close relationship with any Palæarctic or American genus known to me. It differs from *Acalypta* in some of the most important characters, and yet it cannot be placed elsewhere with much greater propriety. Further material in the genus will be awaited with great interest.

Corythucha Stal.

As I am hoping to treat the North American forms of this genus in a later paper, I shall make no other comment here than to point out that while most of the new species recently described by Osborn and Drake are very distinct and well known forms, there are some which cannot be located without reference to the types, because it is impossible to deduce from the descriptions an adequate notion of the important characters derived from exact relative width and height of the hood and from the altitude of the median carina with reference to that of the hood.

Galeatus peckhami Ashm.

Of the two examples of this species known to me to have been taken in New England, one was found at Princeton, Me., and the other near the Glen House, Mt. Washington, N. H., both collected by Mr. C. W. Johnson. I have already published the latter record,[1] which may be what Osborn and Drake erroneously refer to on page 237 of their first paper. Uhler in his paper[2] on the Hemiptera of Las Vegas Hot Springs, N. M., makes reference indefinitely to Massachusetts in discussing the distribution of this species, but as is the case with so many of the faunistic generalizations of this author, confirmatory records of actual capture are desirable if one is seeking exact knowledge.

Leptobyrsa rhododendri Horv.

Champion has recently shown[3] that *L. explanata* Heid. is synonymous with Horváth's previously published name. The species was first described from Holland where it was found infesting rhododendrons, probably as a visitor from the United States, and recently it has similarly occurred in England. As noted by Champion, Heidemann's generic reference is correct, as the lateral pronotal carinae are percurrent in this species and not abbreviated as in *Stephanitis* Stal.

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[1] Ent. News, Vol. 27, 1916, p. 105. The Connecticut record for *Zelus socius* Uhl. given in this paper pertains to *Z. audax* Banks.

[2] Proc. U. S. N. Mus., Vol. 27, 1904, p. 362.

[3] Ent. Mo. Mag., Vol. 52, 1916, p. 207–208.

Leptoypha Stal.

The rather common misspelling, *Leptophya*, is perpetuated by Osborn and Drake on page 241 of their first paper. In their generic diagnosis it is the posterior "tip" of the rostral sulcus which is described as open, though in reality it is nearly or quite closed by the convergent ends of the metasternal ridges. In *L. mutica* Say the head is provided with five spines as in related forms.

The chief characters separating *Leptoypha* from closely allied genera may be stated as follows: Entire surface very finely and evenly reticulate; antennæ short, cylindrical, the third segment not greatly longer than the others together; hood absent; lateral carinæ absent or vestigial; paranota linear, cariniform; costal area linear or narrow and uniseriate; subcostal area with 4–6 rows of areoles.

Leptoypha costata sp. nov.

Long-winged form.—Brown, shining, evenly and finely reticulate; more or less variegated with vague darker markings; pronotum with a black transverse suture interrupted at middle; body beneath chestnut brown, sternal region infuscated.

Head broad; vertex punctate at middle; basal spines short, reaching base of anterior spines, which are short and curved with apices meeting that of median spine; antenniferous tubercles moderate in size, oblique, rounded exteriorly; antennæ short, cylindrical, minutely pubescent, first and second segments nearly equal, slightly longer than broad, thickest, third slightly more slender, cylindrical, a little less than twice as long as the first two together, fourth somewhat longer than the first, fusiform. Pronotum convex at middle, narrowed anteriorly, depressed behind the narrow raised apical collar; median carina slightly raised but appreciably percurrent; lateral carinæ parallel, exceedingly faint, beginning just anterior to summit of pronotal convexity and extending to margins of angulate process. Paranota[1] linear, cariniform, exterior margin straight, somewhat broader anteriorly. Hemielytra at middle distinctly broader than pronotum, extending a little beyond apex of abdomen; costal area narrow, distinctly uniseriate, biseriate anteriorly; subcostal area with 5 or 6 rows of areoles at most, obtusely angulate at apex of discoidal, which extends beyond middle of hemielytra; sutural with slightly larger areoles apically. Legs rather robust. Rostrum scarcely reaching middle coxæ. Orifices but slightly elevated, narrow, transverse. Pleuræ largely reticulate. Abdomen shining, the segments roughened posteriorly. Hind wings almost as long as hemielytra. Form obovate, broadest behind middle, costal margin nearly straight in apical half. Length ♀, 2.8 mm.; width 1.3 mm.

Holotype and paratype, two ♀ ♀, Marshall Hall, Md., 1 August, 1891 (N. Banks), in M. C. Z. Collection.

This species is easily distinguished from *mutica* by its shorter and broader form, slightly shorter antennæ with more slender third segment and distinctly shorter fourth, somewhat more prominent paranota, and especially by its distinct and completely reticulated costal area which in Say's species is cariniform and perceptibly reticulate only toward apex. The lateral pronotal carinæ are very inconspicuous in *costata* and obsolete or nearly so in *mutica*.

Physatocheila Fieb.

In connection with my treatment of the North American species in a recent paper,[2] it should be made clear that the arrangement of areoles in the costal area is somewhat variable and not always symmetrical, although a majority of specimens exhibit the conditions described. In cases of doubt the other characters mentioned are amply sufficient to insure recognition of the forms.

Melanorhopala Stal.

Our conception of this genus must be slightly modified to accommodate *M. duryi* O. & D. and the new form described below, which, though in my opinion congeneric with *clavata*, exhibits certain marked differences. According to this view the chief characters

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[1] See Jour. New York Ent. Soc., Vol. 24, 1916, p. 8. Crampton in a morphological paper has proposed this convenient name for the lateral expansions of the pronotum.

[2] Psyche, Vol. 23, 1916, pp. 163–168. The holotype of *D. tricornis americana* is in the collection of the Boston Society National History, not in mine, as erroneously stated on p. 164.

of *Melanorhopala* may be stated as follows: Form elongate, depressed, the hemielytra flat or showing only the slightest convexity. Antennæ usually rather long and slender, the third segment cylindrical, usually somewhat curved and enlarged toward the apex in varying degrees. Pronotum tricarinate; hood small and not produced anteriorly; paranota narrow, uniseriate, reflexed vertically or against the pronotal surface. Hemielytra in the long-winged form widely overlapping and broadly rounded at apex, in the short-winged form very slightly overlapping, acute and distinctly divaricate at apex; main veins distinctly costate; costal area usually uniseriate, sometimes irregularly biseriate; subcostal area biseriate.

The following table will assist in separating the species:

1. Third antennal segment slender, not thicker than the fourth except sometimes at extreme apex; size larger 2

Third antennal segment rather thick, cylindrical, slightly clavate toward apex which is one third thicker than the fourth segment; form very broad; length, 3.5 mm. *duryi* O. & D.

2. Costal area (costal membrane of Stal) uniseriate, evenly reticulated; color pale and uniform in general 3

Costal area bi- or triseriate in part, irregularly reticulated; color variegated . . . . *infuscata* sp. nov.

3. Third antennal segment very slender, much thinner than the fourth, abruptly and strongly clavate at apex; fourth segment conical . . . . *clavata* Stal.

Third antennal segment less slender, but little thinner than the fourth, less enlarged at apex; fourth fusiform 4

4. Length less than 5 mm.; form narrow; paranota vertically reflexed; antennæ distinctly though not strongly clavate *obscura* Parsh.

Length more than 5 mm.; paranota reflexed almost or quite against pronotal surface; antennæ scarcely clavate 5

5. Antennæ very long, extending beyond apex of abdomen; second segment distinctly narrowed at base; form narrow *lurida* Stal.

Antennæ much shorter; second segment less narrowed at base; form broad . . . . *uniformis* Stal.

M. duryi O. & D.

The shape of the antennæ in this species is not correctly represented in the figure given by the authors on page 15 of their second paper. In the type specimen the first and second segments are nearly equal in size, the third almost perfectly cylindrical with some slight enlargement toward the apex, decidedly longer in proportion to its thickness than indicated, and slightly curved as in all the other species of the genus except *infuscata*, and the fourth is thinner than the figure shows and fusiform, not conical. The anterior spines of the head are short and decidedly curved, the main veins of the hemielytra though strongly costate are unusually irregular, tending to follow the outlines of the areoles, and the general form is very broad, even for a short-winged form.

M. lurida Stal and M. uniformis Stal.

I believe that these species have been correctly located by Osborn and Drake, as from Stal's descriptions it is impossible to suppose that these species differ from *clavata* in any characters of importance beyond those drawn from the form of the antennæ. I have seen *infuscata* sp. nov. in several collections determined as *uniformis*, but the former differs so strikingly from *clavata*, to which the latter is compared by Stal, that such a view cannot be entertained unless examination of Stal's type should unexpectedly demonstrate its truth.

Melanorhopala infuscata sp. nov.

Long-winged form.—Dark yellowish brown with conspicuous darker markings. Head uniform brown, the spines paler; antennæ dark brown, the fourth segment and apex of third slightly darker. Pronotum broadly and variably infuscated, lateral margins and hood excepted; apex of angulate process yellowish white. Hemielytra variegated with very irregular and variable infuscation of veinlets here and there in all the areas, the infuscation sometimes extending to large portions of the surface; sutural area with a large paler region at apex. Body beneath brown, abdomen broadly pale along median line, narrowly at the lateral margins; genital segment darker. Legs brown; tarsi black. Hind wings fuscous.

Head much as in *clavata*, the median spine arising more posteriorly, between the eyes. Antennæ minutely pubescent, very slender, longer than head and pronotum together; first segment oblong, about as thick as the eye is wide as seen from above, second segment smaller, evenly enlarged toward apex, third very long and slender, thinner than the second, cylindrical, with an almost imperceptible enlargement at extreme apex, almost or quite straight, apex oblique; fourth as long as the first and second together, very slightly thicker than the third, fusiform but not quite regular in shape. Pronotal hood roof-like, a little more elevated than in *clavata;* convexity of pronotum bounded posteriorly by a continuous transverse impression; carinæ very low, uniseriate; paranota reflexed closely against pronotal surface. Costal margin of hemielytra slightly curved in male, more strongly so in female; costal area broader behind middle, irregularly reticulate, uniseriate anteriorly, biseriate at middle, triseriate behind middle, uniseriate at extreme apex; subcostal area almost perfectly and regularly biseriate; discoidal area a little more sinuate exteriorly than in *clavata*, extending much beyond middle of hemielytra; sutural area with larger areoles at apex and along inner margin. Legs and structures of ventral aspect much as in *clavata*, except that the bucculæ are more rounded ventrally, rostrum extends beyond hind coxæ, and the female genitalia encroach farther upon the disc of the abdomen. Wings extending beyond apex of abdomen. Form broader than in *clavata*, male narrower than the female. Length ♂ 5.4 mm., ♀ 5.5 mm.; width ♂ 1.5 mm., ♀ 1.7 mm.

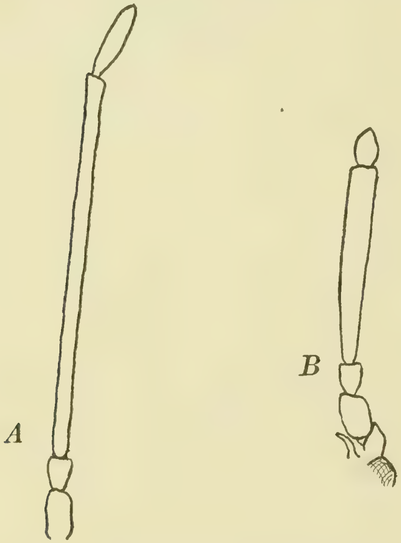

Fig. 1. Antennæ; A, *Melanorhopala infuscata* sp. nov.; B, *Alveotingis grossocerata* O. & D.

Holotype ♂, allotype, and two paratypes, ♂ and ♀, Falls Church, Va., 27, 30 July, 2 August (N. Banks) in M. C. Z., Barber's, and my collection. From bark of tulip tree (Liriodendron).

This species is easily distinguished by its slender inclavate antennæ (fig. 1, A), irregularly reticulate costal area, dark and variegated coloration, and broad form. These characters are not of subgeneric value according to the standards established in the treatment of Palæarctic genera.

Hesperotingis gen. nov.

Form ovate, broadly so in the short-winged forms; surface of hemielytra distinctly but not strongly convex in both forms. Head with two basal spines and three anterior as in allied genera; vertex with a narrow punctate area behind the median spine; antennæ incrassate, the third segment very distinctly clavate, subcylindrical at base and apex. Hood very feebly developed, prothorax otherwise as in *Melanorhopala.* Hemielytra somewhat convex, the areas distinctly limited by moderately costate veins; costal area uniseriate, subcostal almost perfectly biseriate in known species; discoidal narrow, four or five areoles wide at most, slightly sinuate exteriorly, extending beyond middle of hemielytra, similar in long- and short-winged forms; sutural as in *Melanorhopala;* apices of hemielytra not divaricate in the short-winged form. Bucculæ almost or quite contiguous anteriorly, not fused. Metasternal orifices distinct.

This genus is most closely related to *Melanorhopala* Stal and *Alveotingis* O. & D., but I have found it impossible to unite it with either even as a distinct subgenus. From the former it is distinguished by the incrassate, almost evenly clavate antennæ, convex oval form, and nondivaricate hemielytral apices in the short-winged condition, while in habitus it is totally unlike the latter, though similar in antennal structure, the form being much less convex, the hemielytral areas more distinctly defined, and the reticulation less uniform.

Type of the genus *Hesperotingis antennata* sp. nov.

Hesperotingis antennata sp. nov. (Fig. 2).

Long-winged form.—Brown; head, pronotum, and antennæ beyond the middle, infuscated; membranous portions between the veinlets opaque white. Anterior margin of pronotum, hood, anterior portion of paranota, and margins and apical region of angulate process, yellow. Veinlets of hemielytra light brown, a few irregularly darker; veins defining discoidal area, sometimes one running obliquely across it, one extending from its apex, and one near and parallel with sutural margin, dark brown. Abdomen beneath chestnut brown, shining, sutures darker; bucculæ, sternal ridges, and pleural margins pale.

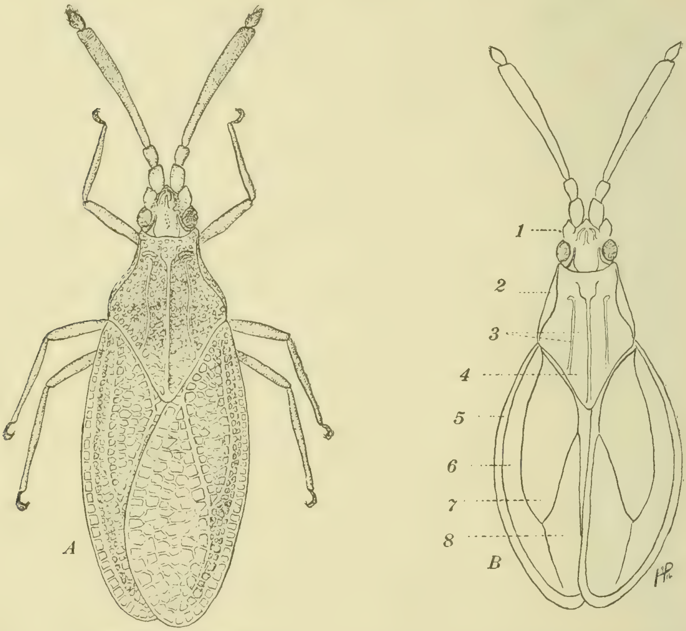

Fig. 2. *Hesperotingis antennata* gen. et sp. nov. A, long-winged ♀; B, short-winged ♀; 1, antenniferous tubercle; 2, paranotum; 3, pronotal carinae; 4, angulate process of pronotum; 5, costal area (costal membrane of Stal); 6, subcostal area (costal of Stal); 7, discoidal area; 8, sutural area (apical of Puton in long-winged form).

Spines of head somewhat variable in length and shape, the two anterior short, strongly curved, and almost or quite meeting over apex of median; eyes strongly granulated, as seen from above longer than wide; antenniferous tubercles as seen from above prominent, convex exteriorly, acute at apex, obliquely truncate. Antennæ almost as long as head and pronotum together; first segment oblong, almost glabrous; second shorter and a little narrower than the first, wider toward apex, with minute decumbent pubescence; third very large, clavate, in basal third more slender than the second, in apical third about as wide as the first is long, with fine pubescence becoming denser toward apex; fourth segment small, conical, more slender than the third at apex, with long dense pubescence. Pronotum transversely convex; narrowed, subcylindrical, and depressed anteriorly, margins and apical half of angulate process depressed, flat; anterior margin arcuate, with a slightly elevated collar of one or two rows of areoles; hood represented by a small backward extension of the collar; paranota reflexed closely against pronotal surface; carinæ low, slightly divergent posteriorly, the extreme apices of the lateral outcurved, terminating at the level of the posterior margin of hood, the median percurrent. Hemielytra extending much beyond apex of abdomen, the marginal vein depressed, the costal area reflexed; sutural area with somewhat enlarged areoles. Bucculæ large, curved ventrally, angulate posteriorly; rostral sulcus deeper and wider posteriorly. Rostrum reaching hind coxæ. Hind wings extending beyond apex of abdomen. Segments of abdomen faintly and irregularly striate on apical half. Genitalia much as in allied species. Form elongate oval. Length ♀ 4.5 mm.; width 1.5 mm.

Short-winged form (fig. 2, B).—Similar in every way to the preceding, except that the general form is broadly oval; pronotum is flat and less broadened posteriorly; the carinæ parallel; hemielytra but slightly longer than abdomen, the costal margin strongly curved, apices narrowly rounded, and sutural area much reduced. Length ♀ 3.7 mm.; width 1.5 mm.

Holotype: long-winged ♀, Lakehurst, N. J., 27 June (H. G. B.) in Barber's collection; paratypes: long-winged ♀, Smiths Point, Fire Island Beach, N. Y., 19 July, 1913 (J. R. T. B.) in de la Torre Bueno's collection; short-winged ♀♀, Delaware Water Gap, 4 September (Mrs. A. T. Slosson) in Barber's collection; New Haven, Conn., 4 September, 1911 (C. E. Olsen) in de la Torre Bueno's collection.

A specimen from Hampton, N. H., 15 August, 1909 (S. A. Shaw) differs from the others in having very slightly shorter and uniformly dark antennæ and the subcostal area somewhat irregularly and asymmetrically reticulated with three rows of areoles in places behind the middle. It does not appear to me to be specifically distinct and in the absence of further material may, for the sake of exact reference, be called var. **borealis** nov. Holotype in M.C.Z. collection.

The example from the Delaware Water Gap, recently submitted to me by Barber, bears the MS. name *Melanorhopala slossoni* Heid.

Hesperotingis fuscata sp. nov.

Short-winged form.—Uniform dark fuscous, pronotum somewhat paler, membrane of areoles opaque gray, main veins of hemielytra black.

Anterior spines of head short, separated, but slightly curved. Antennæ shorter and thicker than in the preceding, the third segment more evenly clavate, being subcylindrical only toward apex, not at base. Hood still more reduced, scarcely noticeable as distinct from the raised pronotal margin; paranota vertical, not applied to pronotal surface; carinæ more strongly elevated, as are the chief veins of the hemielytra; subcostal area biseriate but having a few extra areoles along the middle. Other characters as in the preceding. Form broadly ovate. Length ♀ 3.4 mm.; width 1.4 mm.

Holotype: short-winged ♀, Golden, Colo. (W. J. Gerhard) in Barber's collection.

Easily distinguished from *antennata* by its uniform dark color, antennal shape, and vertical paranota.

Alveotingis O. & D.

This genus is notable for a very peculiar habitus arising from the extremely convex form and shining surface. In most of its characters it closely approaches *Melanorhopala* and *Hesperotingis*, while bearing a certain superficial resemblance to the Serenthiini although it of course lacks the pronotal and femoral structure characteristic of this tribe. It approaches the European *Oncochila* in having the hemielytral areas poorly defined, but differs widely in paranotal structure and in facies. The more important characters of *Alveotingis* may be stated as follows: form elongate oval, hemielytra very convex, their surface smooth and shining, without costate main veins, although the outlines of the areas are traceable. Head as in related genera, the antennal tubercles of the usual structure, as in *Melanorhopala* for instance; antennæ (fig. 1, B) shaped much as in *Hesperotingis*, the third segment clavate, smallest at base and cylindrical toward apex. Thorax as in *Melanorhopala*. Costal area of hemielytra uniseriate in the only known species; subcostal biseriate; discoidal extending beyond middle of hemielytra. In the short-winged form the hemielytra are rounded at apex, not divaricate, in the long-winged they are broadly rounded at apex and widely overlapping. Bucculæ closed anteriorly. Metasternal orifices distinct.

A. grossocerata O. & D.

Probably this specific name must stand for the present, although Oshanin in his catalogue of Palæarctic Hemiptera rejects such on grammatical grounds. The type specimen of this species is a short-winged male. The figure on page 246 of Osborn and Drake's first paper is incorrect in certain important details. The antenniferous tubercles are in reality constructed just as in related genera, and have no very striking similarity to an antennal segment. The third antennal segment is almost evenly clavate (fig. 1, B) and not fusiform as in Osborn and Drake's drawing. The hemielytral areas are traceable, though stated in the description to be undifferentiated, but the main veins are scarcely elevated. The general form is more elongate and narrowed posteriorly than the drawing would indicate. In this species the rostrum reaches the middle coxæ.

Long-winged form.—Pronotum enlarged and convex as in related genera. Hemielytra ample, extending considerably beyond apex of abdomen; costal margin slightly curved; sutural area with areoles grading larger inwardly and toward apex. Hemielytra distinctly more convex than in related genera, and habitus just as in the short-winged form except for structures affected by dimorphism. Length ♀ 3.4 mm.

Described from a female specimen lacking the third and fourth antennal segments and otherwise somewhat mutilated, taken on Mt. Washington, N. H. (W. F. Fiske), and sent to me for examination by Drake. The basal antennal segments are somewhat smaller than in the short-winged type specimen of the species, but this is no doubt due to individual variation as indicated by a short-winged male example intermediate in this regard but otherwise identical, submitted to me by de la Torre Bueno.

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NOTES AND DESCRIPTIONS OF NORTH AMERICAN SERPHIDÆ. (HYMENOPTERA.)[1]

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The family Serphidæ, long familiar to entomologists as the Proctotrypidæ, includes a considerable number of very closely related species from many parts of the world. The group is well represented in the Nearctic region from whence numerous species have already been described. In going over material which has accumulated during a number of years, I have found a few undescribed forms which are described in the present paper.

The first North American species were early described by Say; a couple were added much later by Provancher, but the family received no serious attention at the hands of American entomologists till 1893 when Ashmead[2] published descriptions of all the known North American species. He included twenty-one species, all under the name *Proctotrupes* and considered the group as a subfamily. Since that time a number of species have been added, including some species of the genus *Disogmus* hitherto known only from Europe. Quite recently Kieffer[3] has subdivided the old *Proctotrypes* into four genera, *Serphus* (=*Proctotrypes*), *Cryptoserphus, Phænoserphus* and *Exallonyx*.[4] In the Genera Insectorum he has distributed the North American species in these genera, but has made a few errors owing to lack of North American material. Some of these I have been able to correct, although I have not been able to place definitely several species which I have not seen. In the genera *Serphus* and *Exallonyx* in addition to the descriptions of new species, I have appended keys for the separation of the Nearctic forms with the omission of a few that could not be located generically.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 128.

[2] Monograph of the North American Proctotryphidæ, Bull. U. S. Nat. Museum, No. 45.

[3] Ern. André, Spéc. Hym. Europe et Algérie, vol. 10 (1908), and Gen. Insect., Fasc. 95 (1909).

Many of the new species are from the far West, received from time to time from Professor A. L. Melander, who collected them mainly in Washington. From our present knowledge, it would appear that the family is better represented on the Pacific slope than in the eastern United States, although it is evident that the forms in the East are as yet far from all known.

The figures were all drawn by Mrs. C. T. Brues from camera lucida pencil sketches.

Serphus Schrank.

KEY TO NORTH AMERICAN SPECIES.

1. Petiole of abdomen twice as long as thick; abdomen rufous except at tip. **melliventris** Ashm.
   Petiole of abdomen not longer than thick, usually shorter 2
2. Antennal joints long, third joint over four times as long as thick 3
   Antennal joints shorter, the third only three times as long as thick; body black ....**nevadensis** Kieff.
3. Head, and also most of the rest of the body, ferruginous or rufous... 4
   Head and thorax black, abdomen often rufous in considerable part ... 5
4. Rugosities of propodeum forming distinct longitudinal lines medially and basally, no distinct median longitudinal carina; propodeum black or piceous ....**caudatus** Say.
   Propodeum irregularly rugose, but with a distinct median carina body entirely rufous or fulvous ....**pallidus** Say.
5. Propleura with a large, smooth, shining area above the middle, irregularly striate elsewhere 6
   Propleura without a large, smooth area; its entire surface irregularly striate or sculptured ....**zabriskiei** sp. nov.
6. Propodeum irregularly rugose, with at most a median carina 7
   Propodeum with the rugosities forming a series of longitudinal lines; propodeum long and gradually sloping; abdomen and most of legs reddish. **longiusculus** Brues.

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[4] First described in Bull. Soc. Hist. Nat. Metz, vol. 11, p. 34 (1904).

7. Abdomen, except base and apex, ferruginous or bright rufous; legs yellow or honey yellow 8
   Abdomen black or sometimes partly dull rufous, legs strongly infuscated.. 10
8. Radial cell very short, not longer than the width of the radial vein. **linellii** Ashm.
   Radial cell at least one third as long as the stigma 9
9. Propodeum without any trace of a median longitudinal carina, gradually sloping behind ....**rufigaster** Prov.
   Propodeum with a median carina distinct at least at the base. **terminalis** Ashm.
10. Propleura with a broad, convexly raised longitudinal band extending along its upper portion, separated from the upper edge by a striated groove; abdomen brownish at the base ....**sequoiarum** sp. nov.
    Propleura flat or concave, without a raised band 11
11. Abdominal petiole as broad as long; black with legs, except tibiæ and tarsi, piceous ....**cockerelli** sp. nov.
    Abdominal petiole transverse, much shorter than broad 12
12. Malar furrow present ....**florissantensis** Rohwer.
    No malar furrow ....**debilis** sp. nov.

Serphus zabriskiei new species. (Fig. 1.)

♀. Length 6 mm. (exclusive of ovipositor). Black, abdomen ferruginous beyond the petiole; legs fulvo-ferruginous, four posterior coxæ piceous, lighter at tips, tegulæ fuscous; antennæ brown at extreme base. Head slightly more than twice as wide as thick; malar space slightly longer than the width of the mandibles at base, with a distinct furrow; clypeus broad, its anterior margin convex, its surface densely punctate. Eyes bare. Antennæ very slender; scape twice as long as thick, flagellar joints gradually shortened after the first, which is over five times as long as thick; penultimate joint three times as long as thick. Pronotum one-third as long as the mesonotum, transversely striate in front of the constriction; distinctly trilobed behind. Propleura obliquely striate on its lower half, irregularly longitudinally striate above, without the large, smooth space that is usually present. Mesopleura with a series of longitudinal striæ on its upper half in front of the convex portion, behind with a series of crenate punctures along the edge, which extend forward to form grooves on the posterior third of the lower half of the mesopleura. Propodeum coarsely rugose-reticulate, without areas or any trace of any longitudinal carina. Abdominal petiole quadrate, about as wide as long; second segment at base above with grooves as long as the petiole; ovipositor two-thirds as long as the remainder of the abdomen, straight except at the tip, which is strongly curved downward. Legs slender, tarsal claws simple; longer spur of hind tibiæ one third as long as the metatarsus, the latter as long as the two following joints together. Wings tinged with brownish; radial cell very short, not longer than the width of the radial vein, the latter distinctly prolonged downward and surrounded by a small brown clouded area; discoidal vein indicated as a fuscous streak.

Described from a specimen collected by J. L. Zabriskie at Rochester, N. Y., June 10, 1905. Type in the American Museum of Natural History.

This species may be distinguished from other members of the genus of similar color by the sculpture of the propleura and propodeum and the form of the abdominal petiole.

Serphus sequoiarum new species. (Fig. 2.)

♂. Length 4.5 mm. Black; second abdominal segment, except apex, rufo-ferruginous; legs yellowish brown, anterior femora, tibiæ and tarsi and middle tibiæ light yellow, hind tibiæ somewhat paler than their femora. Head two and one half times as broad as long, malar space as long as the width of the mandibles at base, with a distinct furrow. Clypeus broad, sparsely punctate, its anterior margin straight. Eyes bare. Antennal scape one half longer than thick; first flagellar joint twice as long as the scape, nearly five times as long as thick at apex; following joints decreasing very gradually in length, the penultimate over four times as long as thick and two thirds as long as the first; pronotum less than one third as long as the mesonotum, transversely striate in front of the constriction, trilobed behind. Parapsidal furrows indistinctly defined, but more prominent than usual. Propleura irregularly striate-reticulate anteriorly, smooth behind; its upper portion with a convexly raised band which is separated from the upper edge by a shallow groove or depression that is longitudinally striated and narrower than the elevated portion; the anterior end of the elevation forms the lateral lobe of the pronotum. Mesopleura longitudinally striated above in front of the raised portion and with a series of large punctures inside the posterior edge above the middle; below the middle these are elongated to form short horizontal striæ. Propodeum rugose-reticulate, with a complete median longitudinal carina, but without areas. Abdominal petiole as long as broad; grooves at base of second segment shorter than the petiole. Legs slender; longer spur of hind tibia one third the length of the metatarsus; tarsal claws simple. Wings very slightly tinged with brownish, radial cell very short, but longer than the width of the radial vein; both sections of this vein prolonged downward as brown streaks, the basal streak longer; cubital and discoidal veins indicated as brown streaks.

One specimen collected by Prof. A. L. Melander in the Muir Woods, Marin Co., California.

This species is easily recognizable by the peculiar conformation of the propleura and the conspicuously lighter color of the front legs and middle tibiæ.

Serphus cockerelli new species. (Fig. 3.)

♂. Length 5 mm. Black; four anterior coxæ and all trochanters and femora piceous; tegulæ, tibiæ and tarsi yellowish brown. Head somewhat more than twice as broad as thick. Clypeus higher and less strongly narrowed below than usual, only twice as broad as high, anterior edge slightly arcuate, surface moderately punctate. Malar space longer than the width of the mandible at base, with a fine, distinct furrow. Antennæ slender; scape one half longer than thick; first four flagellar joints scarcely decreasing in length, each fully five times as long as thick; penultimate joint over four times as long as thick. Pronotum transversely striate in front of the constriction, trilobed behind, with the lateral lobes more prominent than the median one. Mesonotum with well marked vestiges of parapsidal furrows. Propleura irregularly and more or less obliquely striate on its lower anterior half; above with a series of five longitudinal striæ below the upper edge. Mesopleura striate between the raised portion and the tegulæ and anteriorly below; below with a series of punctures inside the edge and a small roughened area above the middle coxa. Propodeum coarsely rugose-reticulate, with a complete median raised line; long and very gradually sloping behind. Abdominal petiole as long as broad, roughly rugose, with a median channel above; striate-reticulate below; second segment with the grooves at base extremely short, shorter than the petiole. Legs long and slender; longer spur of hind tibia one third as long as the hind metatarsus; all tarsal claws simple. Wings faintly tinged with brownish; stigma moderately broad; radial cell nearly half as long as the stigma; both sections of the radial vein prolonged into the wing as brown streaks, each for a distance somewhat exceeding its own length; cubital and discoidal veins indicated as brownish streaks.

Type from Eldora, Colorado, August 18. Collected and sent me by Prof. T. D. A. Cockerell.

Serphus debilis new species. (Fig. 4.)

♂. Length 4 mm. Black; tegulæ, knees, front tibiæ and base and apex of four posterior tibiæ brownish yellow; abdomen beyond petiole dull rufous above, especially on the second segment. Head nearly two and one half times as long as thick; ocelli in a nearly equilateral triangle, the posterior ones much farther from the eye-margin than from one another. Malar space longer than the width of the mandible at base; no malar furrow; clypeus over three times as broad as high, its anterior margin nearly straight. Antennal scape twice as long as thick; flagellar joints gradually decreasing in length, the first nearly five times as long as thick; second somewhat stouter, four times as long as thick. Pronotum transversely striate before the constriction, lobed on each side behind; parapsidal furrows obsolete, but evident as slight depressions. Propodeum long, very gradually sloping behind, finely rugose, with a complete, but not strongly defined, median carina. Propleura finely longitudinally striate along its upper edge, below and in front irregularly rugulose-striate; mesopleura with a large, finely striated area below the tegulæ and a coarsely striated one in front below; punctures along hind margin prolonged as striæ on the lower half of the pleura; metapleura finely rugose throughout. Abdominal petiole transverse, seen from above less than half as long as broad; striæ at base of second segment close together, as long as the width of the petiole. Legs long and slender; longer spur of hind tibia slightly more than one third the length of the metatarsus; tarsal claws simple, wings slightly tinged with brownish; radial cell short, about twice as long as the width of the radial vein; second section of the latter prolonged downward as a brown streak; cubital and discoidal veins visible as pale brown streaks.

One specimen, Wawai, Washington, May 20, 1911, A. L. Melander.

This species presents no striking characters, but as indicated in the key to species is distinct; it seems to come nearest to *S. florissantensis* Rohwer with a paratype of which I have been able to compare it.

Cryptoserphus Kieffer.

Kieffer[5] does not place any North American species in this genus, but some undoubtedly belong here as they have the abdominal petiole very short. They do not all show all the other characters attributed to the genus, however, and it may be necessary later to unite *Cryptoserphus* with *Phænoserphus* as has already been suggested by Dodd.[6]

C. flavipes Provancher. Faun Ent. Canada, Hymén., p. 562 (1883) (*Proctotrupes*).

C. clypeatus *Ashm.* Bull. U. S. Nat. Mus., No. 45, p. 339 (1893). (*Proctotrupes.*)

C. abruptus Say.
Complete works, vol. 2, p. 725 (1836). (*Proctotrupes.*)
Ashmead, l. c., p. 339. (*Proctotrupes*).

C. obsoletus Say.
Complete works, vol. 2, p. 725 (1836). (*Proctotrupes.*)
Ashmead, t. c., p. 340. (*Proctotrupes*).

C. belfragei Ashm.
Bull. U. S. Nat. Mus., No. 45, p. 340 (1893). (*Proctotrupes*).

C. flavipes Prov. (Fig. 5.)

Cannot be recognized from his description. As identified by Ashmead, it is easily recognized by its long radial cell and is a *Cryptoserphus*. I have specimens from Woods Hole, Mass., and Black Rock Mt., Ga. (3,500 ft.). In the far West there is another similar species described as *occidentals* on a later page of the present paper.

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[5] Genera Insectorum, fasc. 95, p. 7 (1909).

[6] Trans, R. Soc. South Australia, vol. 39, p. 387 (1915).

C. abruptus Say. (Fig. 6.)

Is also not recognizable from the original description. As redescribed by Ashmead it can be easily identified, although he does not mention the unusually stout legs. The longer spur of the hind tibia is claw-shaped, being distinctly bent and considerably thickened and the hind metatarsus is scarcely longer than the two following joints together.

C. obsoletus Say.

As identified and redescribed by Ashmead it is also a *Cryptoserphus,* and as Say's description will not locate the species definitely, should be accepted as fixing the species.

The two following species may be added:

Cryptoserphus occidentalis new species. (Fig. 7.)

♀. Length 3–4 mm. Black; legs, base of antennæ and abdomen between the third segment and ovipositor brownish yellow. Head slightly more than twice as broad as thick when viewed from above; strongly narrowed below the eyes when seen from the front, the malar space as long as the width of the eye, the width of the clypeus, malar furrow indicated as a small fovea next the eye; anterior margin of clypeus straight or slightly concave. Antennæ slender, moderately long; first flagellar joint five times as long as thick; second to fifth growing gradually shorter, each about four times as long as thick; following growing shorter more rapidly, the penultimate a little more than twice as long as thick. Eyes bare. Pronotum nearly half as long as the head, finely transversely striate before the constriction; humeral angle with a prominent, rounded swelling. Mesonotum with short foveiform parapsidal furrows just behind the humeri, but not indicated elsewhere. Propodeum white pubescent, with a median and pair of lateral carinæ on its basal half, defining two large, smooth areas; also with an ill-defined petiolar area on the rather gradually sloping posterior face, which is reticulate; sides with an indistinct lateral carina extending from the spiracle. Pro- and mesopleura entirely smooth; metapleura in the middle with a large shining area bordered below and behind by a raised margin; depressed, finely sculptured and pale pubescent elsewhere. Abdominal petiole very short, concealed above by the margin of the second segment; base of second segment with numerous basal striæ half as long as the posterior trochanter. Ovipositor slender, slightly curved apically, as long as the basal three joints of the posterior tarsus. Legs slender, longer spur of posterior tibia distinctly more than half as long as the metatarsus. Wings hyaline, stigma not very broad; radial cell as long as the stigma along the costal margin; other nervures not indicated by streaks.

Four specimens: type and one other from Chatcolet Lake, Idaho, Aug., 1915, the other two from Tacoma, Wash., Aug. 28, 1911. All were collected and sent me by Prof. A. L. Melander.

This species is very similar to the eastern *C. flavipes* Prov. in wing venation and length of the tibial spur. It differs most strikingly in the form of the head which is narrowed and lengthened below the eyes, making the malar space longer.

Cryptoserphus melanderi new species. (Fig. 8.)

♂. Length 3 mm. Black, highly polished; legs beyond the trochanters yellow-brown. Head twice as wide as long when seen from above; face strongly convex medially, but without a vertical ridge-like protuberance below the antennæ; clypeal foveæ much more deeply impressed than usual, forming deep pits; clypeus short and broad, with nearly straight lower margin, bulging below the foveæ. Malar space short, with a finely impressed furrow as long as the width of the mandible at base; front with a vertical impression between the base of the antennæ and eye. Antennæ rather stout, conspicuously whitish pubescent. Scape very thick, one half longer than wide; first flagellar joint about four times as long as thick at apex; second a little shorter and stouter; third and following scarcely shorter, but becoming appreciably more slender. Eyes very sparsely pubescent. Pronotum transversely striate before the constriction; behind with the lateral angle produced as a conspicuous, almost acute tubercle. Mesonotum with the parapsidal furrows impressed close to the anterior margin, entirely absent elsewhere. Depression at base of scutellum deeply foveate at each side. Upper face of propodeum with two smooth areas dorsally, these narrowed behind owing to the oblique lateral carinæ; outside of these with a transversely rugose oblong area behind each spiracle; posterior surface somewhat concave and constricted, coarsely reticulate. Pro- and mesopleuræ smooth, the latter with a line of coarse punctures inside its posterior margin; metapleura reticulate, smooth in front above. Abdominal petiole not visible from above; base of second segment above with numerous, fine, parallel grooves nearly as long as the posterior trochanter. Wings hyaline, stigma and veins brown; stigma broad, triangular; radial cell along the costa two thirds as long as the stigma; second section of radius prolonged obliquely downward as a brown streak, cubital and discoidal veins indicated by barely visible brownish streaks. Legs rather stout; longer spur of hind tibia as long as the metatarsus.

Three specimens from Pullman, Wash., May 18, 1909, collected and sent me by my friend Prof. A. L. Melander, for whom the species is named.

This is a very distinct species, recognizable by the deep clypeal foveæ, stout, evenly jointed antennæ, sharply tuberculate prothorax and rather long radial cell.

Phænoserphus Kieffer.

The only North American species belonging to this genus which I have seen is the following:

Phænoserphus longipes new species. (Fig. 9.)

♂. Length 4.8 mm. Black; legs honey yellow; hind coxæ black; base of middle coxæ and middle and hind trochanters fuscous; antennal scape yellow below. Head slightly more than twice as broad as long, strongly narrowed behind the eyes; clypeus short and broad, only one fourth as high as its greatest width; malar space one and one half times as long as the width of mandible at base, no malar furrow. Antennæ moderately thick, with long joints clothed with short pubescence; scape stout, nearly cylindrical, twice as long as wide; first flagellar joint about four times as long as thick; following gradually decreasing in length and thickness, the penultimate two thirds as long as the first and three times as long as thick. Pronotum greatly constricted at the middle, transversely striated in front; its hind angles produced into a distinct rounded swelling. Mesonotum with faint traces of parapsidal furrows anteriorly. Metathorax coarsely rugose-reticulate, with a median carina on its superior face and a somewhat indistinct rounded petiolar area behind; on each side of the median carina is a smoother space bounded by indistinct carinæ, but these basal areas are not clearly defined. Pro- and mesoplurræ entirely smooth and shining, the latter with a series of large foveate punctures inside its posterior edge. Metapleuræ rugose, without any smooth space. Abdominal petiole twice as long as broad seen from above, longitudinally ribbed and transversely rugose between the ribs; second segment long, narrow basally, at base with striæ less than the length of the petiole. Legs long, but not very slender, tarsal claws simple; longer spur of hind tibiæ barely longer than one third the length of the metatarsus. Wings distinctly tinged with brownish; stigma and radial veins fuscous, the cell about half as long as the stigma; both sections of the radial vein extending into the wing as brownish streaks; radial and cubital veins prolonged as brownish streaks.

One specimen from Almota, Wash., June 24 (A. L. Melander).

Exallonyx Kieffer.

KEY TO NORTH AMERICAN SPECIES.

1. Antennal joints short; flagellum slightly thickened toward tip; penultimate joint quadrate or at least scarcely twice as wide as long; basal joints in male simple 2
   Antennal joints elongate, flagellum distinctly attenuated toward tip; penultimate joint about three times as long as thick; basal joints in male frequently with a tooth on the external margin 5
2. Head one and one half times as long as wide; eye removed from posterior margin of head by more than its greatest length. (Fig. 10.) **angusticeps** Brues.

Head but little longer than wide; eye removed from posterior margin of head by about its greatest length or less 3

3. Ovipositor longitudinally aciculate, penultimate joint of antennæ quadrate. 4

Ovipositor with scattered, elongate punctures; penultimate joint of antennæ twice as long as thick .... **similis** n. sp.

4. Antennæ pale at base; median stria at base of second abdominal segment much longer than the lateral ones .... **quadriceps** Ashm.

Antennæ black or piceous throughout; striæ of second abdominal segment nearly equal in length .... **femoratus** Ashm.

5. Males 6

Females 19

6. Some of the basal joints of antennæ with a linear process or tooth near the middle of the external side 7

All joints of antennæ simple, without any projections or processes ... 15

7. First flagellar joint simple, cylindrical, second and several following joints with a process, legs honey-yellow 8

First flagellar joint as well as some of the following ones with a process. 9

8. Antennal flagellum black, eighth joint with a small, but distinct process; larger, western species 6 mm. (Fig. 12.) .... **placidus** Brues.

Antennal flagellum brown, no process on eighth joint; smaller, eastern species .... **fuscinornis** n. sp.

9. Antennal flagellum black 10

Antennal flagellum yellow at base, fuscous apically, eastern species. **ashmeadi** n. sp.

10. Head decidedly less than twice as broad as thick when seen above ... 11

Head approximately twice as broad as long 14

11. Median carina of propodeum complete 12

Median carina of propodeum not extending to apex; processes on basal flagellum joints acute, dentiform .... **dentaticornis** Kieff.

12. Propodeum with a smooth space on each side of the median carina at base 13

Propodeum without smooth spaces .... **crenaticornis** Kieff.

13. First four flagellar joints with a process externally; fifth with a less distinct one .... **fallacicornis** Kieff.

First six flagellar joints with a process, seventh with a faint trace of one. **obscuripes** Brues.

14. Only the first five flagellar joints with a carinate process externally; malar furrow deeply impressed; mesopleura irregularly striate anteriorly. **pleuralis** n. sp.

Seven or eight flagellar joints toothed or with processes; mesopleura entirely smooth and polished. (Fig. 16.) .... **serricornis** Brues.

15. Head approximately twice as broad as long when seen from above ... 16

Head decidedly less than twice as broad as long, strongly narrowed behind the eyes 18

16. Petiole of abdomen long, twice as long as broad; antennæ yellow. **longiceps** Ashm.

Petiole of abdomen not longer than broad 17

17. Propodeum strongly narrowed behind; antennæ not pale at base. (Fig. 17.) **simplicior** Brues.

Propodeum gradually narrower behind; antennæ pale yellow at base. **pallidicornis** n. sp.

18. Propodeum with a strong carina, especially prominent at the apex of its horizontal face, with large, smooth areas basally ......**carinatus** n. sp.

Propodeum with the median carina evident, but not strong; basal smooth areas not clearly defined; head strongly narrowed below toward the mouth ....**parvulus** n. sp.

19. Petiole smooth above and beneath ....**grandis** n. sp.

Petiole longitudinally striate above and beneath ......**longiceps** Ashm. ♀.

E. canadensis and *E. simulans* Ashmead are not included in the above table. *E. californicus* Holmgren is also omitted, as I cannot identify it among the numerous forms from the west which have the flagellar joints dentate in the males. The form referred to this species by Ashmead[7] is evidently not Holmgren's species and is, I believe, the one described on a later page as *E. ashmeadi* sp. nov.

Exallonyx similis new species. (Fig. 11.)

♀. Length 2.5–3 mm. Black; tegulæ, and legs and antennæ in part, yellow; antennæ brownish yellow at base, darkened beyond the middle and fuscous toward apex; legs brownish yellow, the femora above, and hind tibiæ toward apex, dark; middle and hind coxæ piceous, except at apex. Head about as long as broad, gradually constricted behind the eyes. Eyes sparsely pubescent, removed by slightly more than their width from the posterior margin of the head when seen from the side; malar space as long as the width of the eye, without furrow; anterior margin of clypeus straight. Antennæ reaching to base of abdomen; scape twice as long as thick, narrowed at base; first flagellar joint slender, three times as long as thick at apex; second, third and following each scarcely shorter than the preceding, but growing stouter; second two and one half times as long as thick; penultimate twice as long as thick. Mesonotum long and narrow, highly polished; groove at base of scutellum broad and shallow. Propodeum with long horizontal face, abruptly declivous behind; rugose-reticulate on the sides and behind; with a strong median carina above, on each side of which is a smooth space that extends to the top of the declivity. Pro- and mesopleuræ entirely smooth except for several striæ on the mesopleura below and in front of the upper raised portion; metapleura rugose below, shining on upper third. Petiole of abdomen a little longer than wide, rugose above, coarsely striate below; second segment angularly incised at base, with a median stria as long as the petiole and several short lateral striæ; ovipositor acutely pointed, but little curved, as long as the hind metatarsus, sparsely punctate. Legs rather slender, longer spur of hind tibia nearly one half as long as the metatarsus; claws of front and middle tarsi with a long appendage at base. Wings hyaline, without cubital or discoidal streaks; stigma light brown, not very broad, the radial cell short, its outer edge very oblique.

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[7] Bull. U. S. Nat. Mus., No. 45, p. 338 (1893).

Type from Tacoma, Wash., August 28, 1911. Five other specimens from Burton, Wash.; Vashon, Wash.; Pullman, Wash.; and Berkeley, Cal., taken during June and August. All were collected and sent to me by Prof. A. L. Melander.

This species is similar to the eastern *E. quadriceps* Ashm., which it resembles very closely. It is at once separated by the absence of striæ on the ovipositor. From *E. femoratus* Ashm. it is easily distinguished as set forth in the key to species.

Exallonyx fuscicornis new species. (Fig. 13.)

♂. Length 3.5 mm. Black; tegulæ, palpi, scape of antennæ and legs brownish yellow; front and middle coxæ light brown; flagellum of antennæ fuscous; hind coxæ black. Head barely twice as broad as long, strongly narrowed behind; ocelli in a flat triangle, the hind ones farther from one another than from the eye-margin. Eyes removed from posterior margin of head by their own width, bare or nearly so; malar space as long as half the width of the eye, without furrow; head much narrowed below when seen from in front; margin of clypeus straight. Antennæ reaching to basal third of second abdominal segment; scape twice as long as thick; first flagellar joint simple, without process, not quite three times as long as thick and subequal to the second, third and fourth; following slightly shorter, subequal, becoming more slender; second to seventh joints each with a carina externally on the basal half that forms a dentate process at the middle of the joint, those on the second and seventh less prominent. Mesonotum polished, without trace of parapsidal furrows; depression at base of scutellum broad and rather deep behind. Propodeum short, its horizontal face but little longer than the declivity; basally with an indistinct median carina, but with the basal smooth space very short; elsewhere rugose-reticulate. Propleura smooth. Mesopleura with a small striate area anteriorly near the base of the front coxa and with the lower punctures near its hind margin prolonged into short striæ; metapleura with a very small, smooth space above. Petiole of abdomen wider than long, with a few coarse, irregular ridges above, coarsely striate below; basal striæ on second segment coarse, of equal length, as long as the petiole. Legs stout, longer spur of hind tibia slightly over one half the length of the metatarsus; front and middle tarsal claws with a long, slender appendage at base. Wings hyaline tinged with brownish, cubital and discoidal veins very finely indicated as brownish streaks; stigma moderately broad; radial cell very short, the outer vein entering the costal margin at an angle of about 45°.

One specimen from Woods Hole, Mass., collected by the writer during July, 1902.

Distinguished from *E. ashmeadi* sp. nov., the only other species with dentate antennæ known from the Eastern states, by the simple first flagellar joint. It is quite possibly the male of some described species known only in the female sex, but I cannot associate it with any degree of certainty.

Exallonyx ashmeadii new species. (Fig. 14.)

♂. Length 3.5–4 mm. Black; tegulæ, legs, and base of antennæ honey-yellow; middle and hind coxæ blackish on basal half; antennæ blackish on apical half. Head almost twice as broad as thick, not very much narrowed behind the eyes; ocelli in a flat triangle, the posterior pair as far from one another as from the eye-margin; seen from the side, the eyes are removed from the hind margin of the head by a little less than their width; malar space as long as half the width of the eye, with a delicately impressed furrow, deeper above near the eye. Clypeus with the anterior edge straight; head much narrowed below when seen in front view. Antennæ reaching to the base of the second segment of abdomen; first to sixth flagellar joints each with a carinate process externally, more prominent on the second, third and fourth joints, and very small on the sixth. Scape slightly more than twice as long as thick; flagellar joints gradually decreasing; first three times as long as thick; others in approximately the same proportion except the elongate slender last joint. Mesonotum smooth, much narrowed anteriorly, without trace of furrows; depression at base of scutellum narrow, deep. Propodeum sharply declivous behind, the horizontal portion much longer than the declivity; median carina distinct on horizontal face; smooth areas on each side of carina distinct, half as long as the carina; propodeum elsewhere rugose-reticulate. Pro- and mesopleuræ smooth, the punctures before the posterior edge of the latter not elongated below; metapleura with a round fovea and crescentic smooth space above. Abdominal petiole as broad as long, roughly sculptured above, coarsely striate below; second segment with the basal striæ short, of equal length, the lateral one widened into a broad depression behind. Legs long, rather stout; longer spur of hind tibia half as long as the metatarsus, claws of four anterior tarsi each with a long, stout appendage at base. Wings hyaline without cubital or discoidal streaks; stigma rather broad, radial cell half as long as the stigma, the vein entering the costa at an angle of about 45°.

Type and three other specimens from Machias, Maine, July 20, 1909; a fourth specimen from Eastport, Maine, July 14. All were collected by Mr. C. W. Johnson. Type in the collection of the Boston Society of Natural History.

I believe that this is the form mentioned by Ashmead from the Eastern states as *Proctotrupes californicus* Holmgren. It is distinct from any western form that I have seen.

Exallonyx pleuralis new species. (Fig. 15.)

♂. Length 4.8–5.2 mm. Black; tegulæ and legs yellow, the anterior coxæ blackish at base and the four posterior ones black except at extreme tips; middle and hind tarsi dark fuscous, except at base; pedicel of antennæ rufous. Head fully twice as wide as long, considerably narrowed behind the eyes; ocelli in an equilateral triangle, the posterior pair closer to one another than to the eye-margin; seen from the side the eye is removed by its own width from the posterior margin of the head. Malar space less than half the width of the eye, with a deeply impressed furrow. Head not much narrowed below, the clypeus broad, its margin straight or somewhat concave; front above the antennæ with a prominent depression on each side of the intra-antennal carina. Mesonotum sharply narrowed in front, posterior corner of pronotum with a pronouned convex elevation; no trace of parapsidal furrows; depression at base of scutellum deep. Propodeum coarsely rugose-reticulate, more finely so basally, but without any entirely smooth basal areas; median carina very indistinctly defined; in profile the declivity is gradual but rather steep posteriorly. Propleura smooth. Mesopleura with some oblique striæ in front of the elevated portion and with a narrow band of longitudinal striæ below it; the punctures along its posterior edge not elongated into striæ. Metapleura with a shining space above. Petiole of abdomen quadrate, with coarse reticulations above and striæ beneath; basal striæ on second segment longer than the petiole, of equal length. Legs long and rather slender; longer spur of posterior tibia nearly half as long as the metatarsus; tarsal claws of four anterior legs with a long appendage at base. Wings very slightly tinged with brown; stigma large and broad, radial cell one half as long as the stigma, radial vein meeting the costa at an angle of much more than 45°, second section of radius prolonged downward as a brown streak; discoidal vein, and the cubital less distinctly, indicated as brownish streaks.

Type and two other specimens from Monroe, Wash., May 20, 1908. (A. L. Melander.)

This nice large species is most easily distinguished from related forms by the sculpture of the mesopleura and the absence of processes on the sixth and seventh flagellar joints.

Exallonyx pallidicornis new species. (Fig. 18.)

♂. Length 2.5–3 mm. Black; legs, including coxæ, tegulæ, palpi, and base of antennæ pale brownish yellow; hind coxæ at base, hind femora above and hind tarsi infuscated; antennæ becoming darker toward apex; mesopleura below piceous. Head fully twice as broad as long, ocelli close together in a flattened triangle; posterior pair a little closer one to another than to the eye-margin. Seen from the side the eye is removed by somewhat less than its width from the posterior margin of the head. Malar space barely as long as half the length of the eye, with an indistinct furrow. Head considerably narrowed below; clypeus with a concave lower margin. Antennæ reaching to the basal third of the petiole of abdomen, all joints simple, cylindrical; scape narrowed basally, twice as long as thick; first joint three times as long as thick, distinctly longer than the second which is two and one half times as long as thick; following gradually growing shorter and thinner; penultimate two and one half times as long as thick. Mesonotum shining, without trace of parapsidal furrows; seen from above the sides of the thorax are concave in front of the tegulæ, due to the concave form of the propleuræ; posterior corners of pronotum not produced into distinct swellings or tubercles. Propodeum rugose with a distinct median carina on its upper face; sharply declivous behind; at the base with a small smooth area on each side which does not extend inward to the median line. Pro- and mesopleuræ entirely smooth; punctures inside the posterior margin of the mesopleura slightly elongated below; metapleura finely rugose, with an extremely small, smooth space above. Petiole of abdomen broader than long, irregularly sculptured above, coarsely striate below; grooves at base of second segment longer than the petiole, of nearly equal length. Legs slightly thickened, especially the posterior femora; longer spur of hind tibia one half as long as the metatarsus; tarsal claws of four anterior legs each with a long, very stout appendage at the base. Wings hyaline, stigma broad, radial cell nearly half as long as the stigma, the radial vein entering the costa at an angle of about 45°; disc of wing without streaks or traces of other veins.

Three specimens, the type from Putman, Conn., July 12, 1905 (H. L. Viereck); others from Wisconsin, October. (W. M. Wheeler.)

Exallonyx carinatus sp. nov. (Fig. 19.)

♂. Length 3.5 mm. Black; antennæ piceous, tegulæ and legs beyond the trochanters fulvous; trochanters, except extreme tip and tarsi, fuscous, anterior coxæ yellowish at tips. Head about one half wider than long, full behind the eyes and then suddenly narrowed; ocelli in a slightly flattened triangle, the posterior ones as far from one another as from the eye-margin. Eyes removed by a little more than their own width from the posterior margin of the head. Malar space as long as half the width of the eye, with a distinct furrow. Head gradually narrowed below, the anterior margin of the clypeus strongly arcuate. Antennæ slender; scape narrow at base, twice as long as thick; flagellar joints simple, first considerably longer than the second, four times as long as thick; second and following decreasing in length, all about three times as long as thick. Thorax strongly narrowed in front, mesonotum smooth, without trace of parapsidal furrows; posterior corners of pronotum rounded, not produced; groove at base of scutellum broad and deep. Pro- and mesopleuræ smooth; the punctures inside the posterior margin of the latter very small above, larger but not elongated below. Propodeum long above, suddenly declivous behind, with a strong carina that is especially prominent on the declivity above and suddenly ends there; above on each side of the carina with a long triangular smooth area covering most of the dorsal face; elsewhere coarsely rugose-reticulate. Metapleura with a rather large, raised, smooth space above. Abdominal petiole as long as wide, coarsely roguse above, striate below; striæ at base of second segment somewhat longer than the petiole, the lateral ones not so long as the median one. Legs not thickened; longer spur of hind tibia nearly half as long as the metatarsus; appendage at base of four anterior tarsal claws stout, shorter than the claw. Wings slightly tinged with yellowish or brownish; stigma broad, sub-triangular; radial cell one third as long as the stigma, radial vein meeting the costa at an angle of more than 45°; other veins not indicated as streaks.

One specimen from Oroville, Wash., May 1, 1912 (A. L. Melander).

This species is readily distinguishable by the sculpture of the propodeum in addition to other characters given in the key to species.

Exallonyx parvulus new species. (Fig. 20.)

♂. Length 2–2.5 mm. Black; tegulæ yellowish brown, antennæ piceous, legs yellowish brown, but strongly infuscated on the trochanters and femora, and less strongly so on the tarsi of the four posterior legs. Head about one half broader than long, considerably and evenly narrowed behind; ocelli in a flattened triangle, the posterior pair equidistant from one another and from the eye-margin. Malar space nearly as long as half the width of the eye, with a distinct furrow. Head strongly narrowed below, the margin of the clypeus straight or slightly concave. Eyes sparsely pilose. Antennæ rather short and stout, especially at base; the flagellar joints simple; first three times as long as thick, considerably longer than the second, which is scarcely over twice as long as thick; following imperceptibly shorter and thinner, the penultimate, however, longer than the antepenultimate. Thorax narrowed in front of the tegulæ, its sides distinctly concave. Posterior corners of prothorax convexly elevated; mesonotum smooth without trace of parapsidal furrows. Impression at base of scutellum sharp and deep. Propodeum coarsely reticulate, its posterior face strongly declivous and not much shorter than the dorsal face; median carina distinct to apex, but stronger basally; smooth areas at sides of median carina distinct basally, but gradually passing over to the reticulate sculpture on the sides and behind. Pro- and mesopleuræ smooth; the punctures inside the posterior border of the latter enlarged into short striæ below the middle of the pleura; metapleuræ rugose below, smooth above, but the smooth space not clearly limited. Petiole of abdomen quadrate, irregularly sculptured above, coarsely striate below; grooves at the base of second segment of about equal length, longer than the petiole. Hind legs somewhat thickened; longer spur of hind tibia half as long as the metatarsus; appendage at base of the tarsal claws of the four anterior legs stout at base, as long as the claw. Wings hyaline, stigma narrowly triangular; radial cell nearly half as long as the stigma; radius entering the costa at an angle of less than 45°; disc of wing without trace of any streaks.

The legs and antennæ vary in some specimens and are often lighter than in the type.

Thirteen specimens from widely scattered localities on the Pacific Coast. Type from Oroville, Wash., April 1. Others from Burton, Wash. (Aug. 19); Vashon, Wash. (Aug. 18, 1910); Chinacum, Wash. (Aug. 23, 1910); Colby, Wash.; Puget Sound, Wash.; Berkeley, Calif. (Aug. 8, 1915); Muir Woods, Calif. (Aug. 7, 1915). All but one were collected and sent me by Prof. A. L. Melander.

This is a small species without any striking peculiarities, but quite distinct as indicated in the key to species.

Exallonyx grandis new species. (Fig. 21.)

♀. Length 8.5 mm. Black; legs except middle and hind coxæ ferruginous; antennæ fuscous, rufous at base; middle coxæ dark rufous, hind coxæ black, except at apex; tegulæ fulvous; palpi brownish yellow. Head seen from above as broad as long, very slightly narrowed behind the eyes; triangularly produced in front of the eyes. In lateral view the eyes are removed from the posterior margin of the head by one and one half times their width. Ocelli in a nearly equilateral triangle, as far from one another as from the eye-margin. Eyes sparsely pilose. Malar space as long as the eye, without trace of any furrow. Clypeus not separated from the face medially, with very deep lateral foveæ, anterior margin straight, with a linear impression along the margin and a lanceolate one just above this. Antennæ of equal thickness throughout the flagellum; scape twice as long as thick; first joint of flagellum five times as long as thick; second three fourths as long; following gradually growing shorter, last only about a fourth longer than the penultimate. Thorax gradually narrowed in front; posterior corners of prothorax not tuberculate or swollen. Scutellar impression deep. Propodeum long, its upper surface gradually curving down to tip, with a strong, complete median carina, with a broad, smooth space on each side of the carina, becoming narrower behind and somewhat tuberculate on the posterior third, rugose-punctate laterally. Pro- and mesopleuræ entirely smooth; line of punctures along hind margin of latter enlarged into short striæ below the middle. Metapleuræ rugose-reticulate, with a small, smooth space above. Petiole of abdomen over twice as long as thick, tubular, but strongly arcuate, being bent up at each end; entirely smooth both above and below; second segment at base with only a median stria which is as long as the petiole; discal cicatrices oblique and lying close to the stria. Femora very stout; longer spur of hind tibia one third as long as the metatarsus. Appendage or tarsal claws of four anterior legs as long and about as stout as the claw. Wings distinctly tinged with brown; stigma narrow, small; radial cell nearly as long as the stigma; the radial vein entering the costa at an angle of about 45°. Cubital and discoidal veins indicated as brown streaks; second section of radius, and first to a less extent, prolonged as brown streaks into the disc of the wing.

One specimen from Ramsey, N. J., August 22, 1909. Type in American Museum of Natural History.

This fine large species is very similar to *E. longiceps* Ashm. in appearance, but is easily distinguished by the petiole of the abdomen being entirely smooth. The petiole is striate in both sexes of *E. longiceps.*

EXPLANATION OF PLATES I AND II.

Fig. 1. *Serphus zabriskiei* new species. *a,* apex of abdomen and ovipositor; *b,* stigma and cell; *c,* base of flagellum of antenna.

Fig. 2. *Serphus sequoiarum* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 3. *Serphus cockerelli* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 4. *Serphus debilis* new species. Stigma and cell of wing, and base of flagellum of antenna.

Fig. 5. *Cryptoserphus flavipes* Prov. Stigma and cell of wing and base of flagellum of antenna.

Fig. 6. *Cryptoserphus abruptus* Say. Stigma and cell of wing and base of flagellum of antenna.

Fig. 7. *Cryptoserphus occidentalis* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 8. *Cryptoserphus melanderi* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 9. *Phænoserphus longipes* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 10. *Exallonyx angusticeps* Brues. Stigma and cell of wing and flagellum of antenna.

Fig. 11. *Exallonyx similis* new species. Stigma and cell of wing and base of flagellum of antenna.

Fig. 12. *Exallonyx placidus* Brues. Stigma and cell of wing and base of flagellum of antenna.

Fig. 13. *Exallonyx fuscicornis* new species. Stigma and cell of wing and second to sixth joints of flagellum of antenna.

Fig. 14. *Exallonyx ashmeadi* new species. Stigma and cell of wing and base of flagellum of antenna.

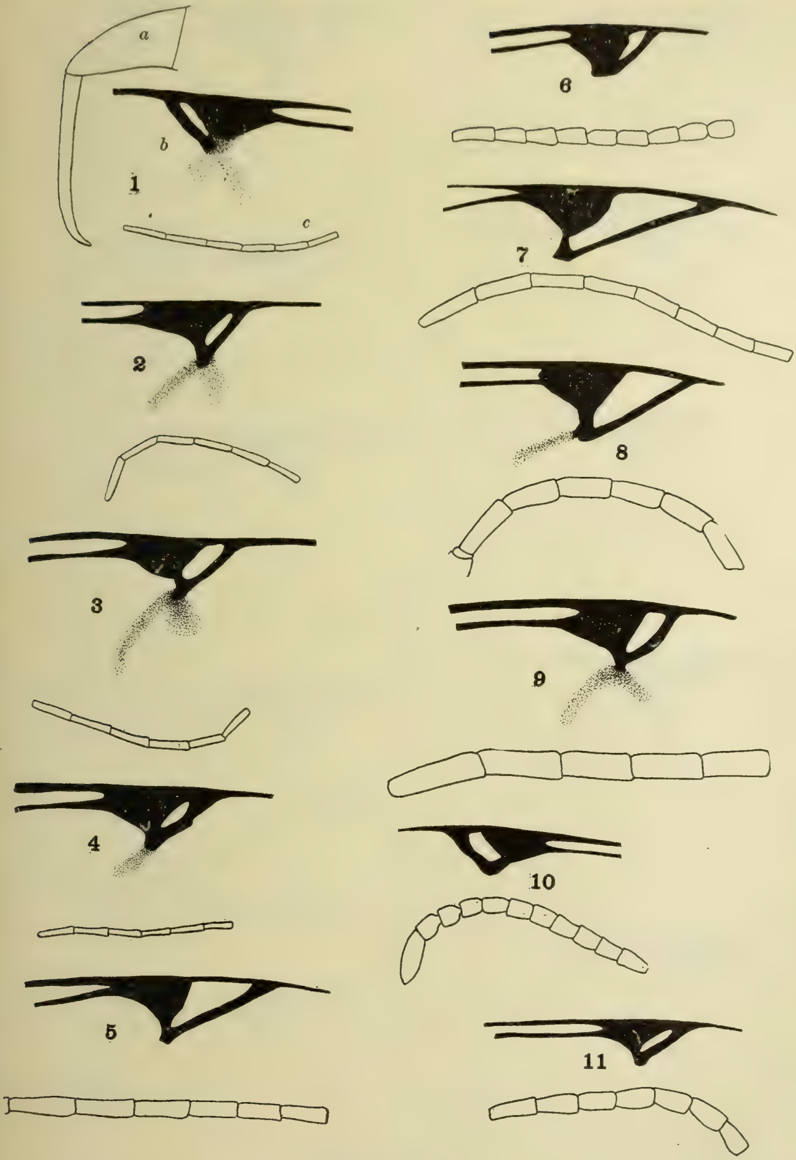
Fig. 15. *Exallonyx pleuralis* new species. Stigma and cell of wing.

Fig. 16. *Exallonyx serricornis* Brues. Stigma and cell of wing and base of flagellum of antenna.

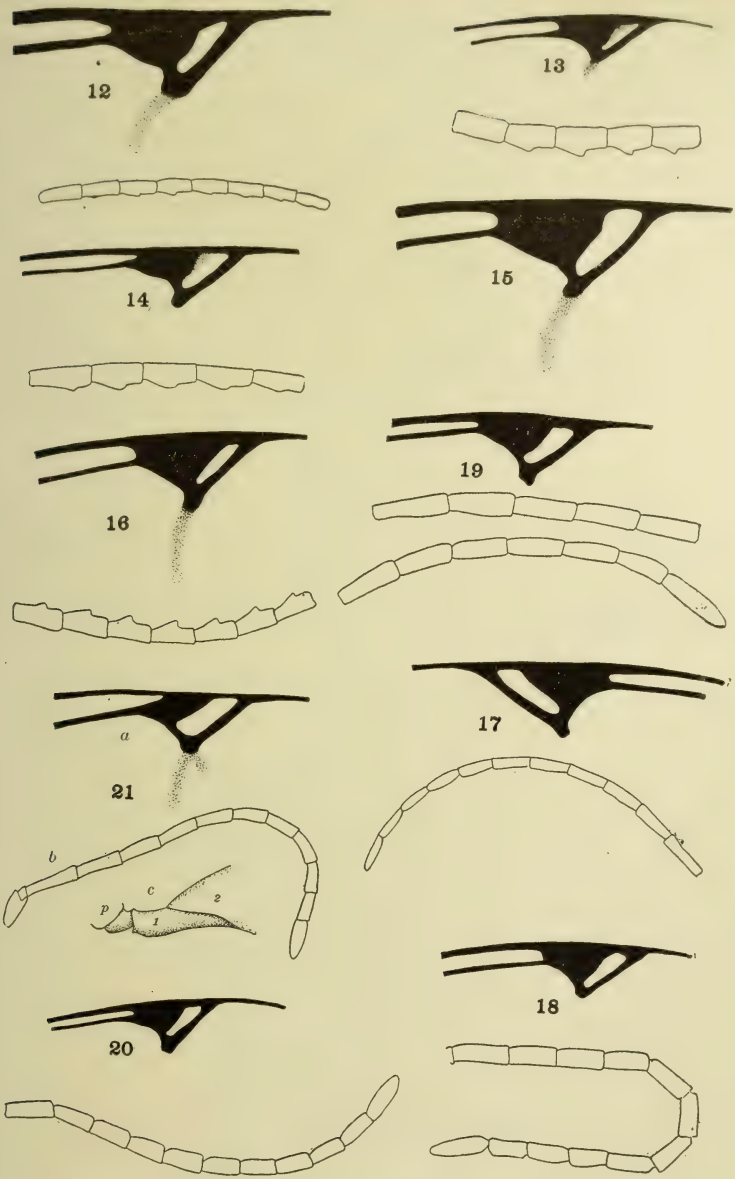
Fig. 17. *Exallonyx simplicior* Brues. Stigma and cell of wing and flagellum of antenna.

Fig. 18. *Exallonyx pallidicornis* new species. Stigma and cell in wing and flagellum of antenna.

Fig. 19. *Exallonyx carinatus* new species. Stigma and cell of wing and flagellum of antenna (first five joints above, last seven below).



Serphidæ.



Serphidæ.

Fig. 20. *Exallonyx parvulus* new species. Stigma and cell in wing and flagellum of antenna.

Fig. 21. *Exallonyx grandis* new species. *a,* stigma and cell of wing; *b,* flagellum of antenna; *c,* petiole of abdomen; (*p,* propodeum; *1,* petiole; *2,* second abdominal segment).

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THE AUSTRALIAN ANTS OF THE PONERINE TRIBE CERAPACHYINI.

By William Morton Wheeler.

(Continued from page 3 of cover.)

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1. Collins, Frank S., and Hervey, Alpheus B.— The Algae of Bermuda. pp. 1–195. 6 pls. August, 1917. $1.75.
2. Rehder, Alfred.— The Genus Fraxinus in New Mexico and Arizona. pp. 197–212. October, 1917. 25c.
3. Wheeler, William Morton.— The Australian Ants of the Ponerine Tribe Cerapachyini. pp. 213–265. January, 1918. 80c.

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THE AUSTRALIAN ANTS OF THE PONERINE TRIBE CERAPACHYINI.

By William Morton Wheeler.

THE AUSTRALIAN ANTS OF THE PONERINE TRIBE CERAPACHYINI.[1]

By William Morton Wheeler.

Received, September 29, 1917.

The Cerapachyini are of unusual interest to the myrmecologist, because they represent one of the most primitive sections of the most primitive subfamily of ants, the Ponerinæ, and because they are so closely related to the subfamily Dorylinæ as to suggest that the latter must have arisen from Cerapachyine ancestors. Owing, however, to the fact that all the species of the tribe are rare and sporadic and confined to warm countries, our knowledge of the habits and sexual forms of the species and of their distribution is still very inadequate. In a country like Australia which preserves such a large portion of the ancient Mesozoic ant-fauna, we should expect to find the tribe well represented in genera and species, and this proves to be true.

The workers of the Cerapachyini are easily recognized by their long, slender, jointed bodies; the petiole and postpetiole of the abdomen are distinct and in one of the genera (*Eusphinctus*) even the gastric segments are marked off from one another by pronounced constrictions. The eyes are often lacking, the antennæ are robust and well developed, the clypeus is very short and vertical, and the frontal carinæ are erect and closely approximated, so that the insertions of the antennæ are exposed. The thoracic sutures are very feeble or entirely absent. In the males the mandibles are well developed, the genital appendages are retracted and there are no cerci. The females are sometimes worker-like and apterous, though possessing eyes or both eyes and ocelli (*Nothosphinctus, Eusphinctus*); in other species the thorax has distinctly differentiated sclerites and bears wings, though the mesonotum and scutellum are very small; in still others the thorax has differentiated sclerites but bears no wings (*Cerapachys, Phyracaces*). The larva of only one species has been described, that of the Texan *Cerapachys* (*Parasyscia*) *augustæ* Wheeler (Psyche 1903, pp. 205–209). In the present paper I have sketched the larva of *Eusphinctus steinheili* Forel (Fig. 2). It is very long and slender, non-tuberculate and covered with bifurcate hairs. No pupæ of Cerapachyini have been seen, so that we are unable to say whether they are naked or enclosed in cocoons like the pupæ of all other Ponerinæ, except those of the genus *Discothyrea.*

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 129.

Emery in the "Genera Insectorum" recognizes four genera of Cerapachyini, all of which are represented in Australia, namely, *Sphinctomyrmex, Cerapachys, Phyracaces* and *Lioponera,* the first comprising the subgenera *Sphinctomyrmex* s. str. and *Eusphinctus,* the second four subgenera: *Cerapachys* s. str., *Parasyscia, Oöceræa* and *Syscia.* Of the latter only *Syscia* is known to be represented in Australia. The taxonomic status of some of these groups is still doubtful, owing largely to incomplete information concerning their sexual phases. Emery (Zool. Jahrb. Abt. Syst. 8, 1895, p. 693, Pl. 14, Fig. 4) described and figured the genitalia of a male of an undetermined species of *Eusphinctus,* presumably from the Indomalayan region. He found that the inner paramera terminate as vertical plates with dentate inferior borders, and that the vosellæ are movably articulated, well differentiated and bear a vestigial lacinia at their bases. Of the males of the Australian species which have been included in the genus *Sphinctomyrmex,* nothing is known. Santschi has recently described a male ant from Africa as *S. rufiventris,* but its generic status seems to me to be open to doubt. The peculiarities of the females of the Australian forms have, in my opinion, an important taxonomic bearing, as will be evident from the following considerations.

The genus *Sphinctomyrmex* was erected by Mayr (Verh. zool. bot. Ges. Wien 16, 1866, p. 895, Pl. 20, Fig. 8) for the accommodation of a single deälated female specimen described from Brazil as *S. ståli.* During half a century no one has succeeded in again finding this insect. Mayr's figure shows that its thorax has well developed sclerites essentially like those in ordinary female ants. The antennæ are 12-jointed, the pygidium emarginate. In 1895 Emery erected a genus *Eusphinctus* for a worker ant (*E. furcatus*) from Lower Burmah, with 11–jointed antennæ, but with the pygidium emarginate and the gastric segments separated from one another by deep constrictions as in the Brazilian *ståli.* In 1897 a second species (*E. cribratus*) was described by Emery from New Guinea and Forel added a third from Bengal (*E. taylori*) in 1900. Only workers of these forms have come to light. In the meantime Forel received several species from Australia, some of which had 11-jointed, while others had 12-

jointed antennæ. He therefore concluded that *Eusphinctus* was merely a subgenus of *Sphinctomyrmex*. An examination of the Australian specimens convinced him that each colony of *Eusphinctus* contained two kinds of workers, one small and eyeless, the other large and possessing eyes and ocelli. As a somewhat similar dimorphism of the worker caste had been found in the European *Ponera eduardi*, he inclined to the view that the eyed individuals of *Eusphinctus* were gynæcoid workers, but he was baffled by these forms, which kept turning up, often in considerable numbers in colonies received from Australia. Later, in a species of what he regarded as *Sphinctomyrmex* s. str. (*S. imbecillis*) from South West Australia, he found a single large, eyeless individual, much like a worker, but more pilose, with more convex sides to the head and much larger gaster, more feebly constricted between the segments. This specimen he designated as an "ergatomorphic female" and noted its resemblance to the dichthadiigynes of the Dorylinæ on the one hand and to the large-eyed, shorter-headed and more pilose workers of *Eusphinctus* on the other, but confessed himself to be even more baffled in his attempts to interpret the personnel of colonies of Australian *Sphinctomyrmex*. In 1905 Ernest André (Rev. d'Ent. 24, 1905, p. 205) found the two types of individuals in a new species of *Eusphinctus* (*E. duchaussoyi*) from Sydney, N. S. W., and expressed the following opinion in regard to their meaning: "I consider the individuals with eyes and ocelli as ergatoid females and not as gynæcoid workers, although Forel inclines to the latter hypothesis so far as *E. steinheili* is concerned. My opinion is based on the fact that up to the present time no normal females have been found in any of the known species of the genus *Eusphinctus* and that probably such females do not exist but are replaced by ergatoids, a condition not without precedent in the ant-world. One may, of course, say by way of objection that the type of the genus *Sphinctomyrmex*, of which *Eusphinctus* is regarded as a subgenus, is based on a female with normal characters, but I would reply that its worker is still unknown, so that it is not certain that the described female, which is American, belongs to the same genus as the Asiatic and Australian species. I believe rather, till proof to the contrary is forthcoming, that the genus *Sphinctomyrmex* should be restricted to the single *S. ståli* of Brazil, which is the type, and that all the Asiatic and Australian species should constitute the genus *Eusphinctus* Emery, without distinction between those having 12 or 11 antennal joints. Besides such characters as may be exhibited by the still unknown worker of *Sphinctomyrmex*, this genus is characterized by a normal female, whereas the female of *Eusphinctus* is ergatomorphic."

Emery in the "Genera Insectorum" (Fasc. 118, 1911, p. 6) adopted André's interpretation of the eyed individuals but not his suggestion to restrict *Sphinctomyrmex* to the Brazilian type and to place all the Old World forms notwithstanding the differences in the number of antennal joints in the genus *Eusphinctus*. My study has led me not only to adopt André's suggestion but to go even further. There are evidently not two, but three groups of subgeneric status among the Australian forms. One of these comprises a single species, *E. turneri* Forel, known only from the worker, which is large, black, with 12-jointed antennæ, well-developed eyes, but without ocelli and with an emarginate pygidium. The two other groups have blind workers with entire pygidium, but differ in the number of antennal joints, *Eusphinctus* s. str. having 11, and the other group 12 (*Sphinctomyrmex* s. str. of Emery and Forel). Now the following facts show that the females of these two groups, though like the workers in form, differ in size and in the visual organs and shape of the pygidium:

1. No workers or worker-like individuals with well-developed eyes and ocelli are known in the group with 12-jointed antennæ (with the possible exception of *S. myops* Forel, which may be a female!).

2. An "ergatomorphic female" of *S. imbecillis* was described by Forel as being considerably larger than the worker, without eyes or ocelli, with scarcely constricted gastric segments and with emarginate pygidium.

3. Dr. W. M. Mann loaned me for study a fine colony of a new species closely related to *imbecillis*, which he recently discovered in New South Wales (*manni* sp. nov.). This colony comprises 227 blind workers varying from 3 to 5 mm. in length, and a single much larger, worker-like individual 7 mm. in length, with very minute eyes and the anterior ocellus, but in all other respects, except the somewhat larger size, like the ergatomorphic female of *imbecillis* described by Forel. Even in the field Dr. Mann at once recognized this individual as the queen of the colony.

4. In the known Australian species of *Eusphinctus* s. str. each colony contains several large, eyed and ocellate worker-like individuals. Since these individuals differ from the blind workers in many of the characters exhibited by the ergatomorphic females of *imbecillis* and *manni* (greater size and more voluminous gaster, shorter and laterally more convex head, more abundant pilosity), André's and Emery's view that they are the only true females among these ants, seems to

me more acceptable than Forel's supposition that we are here concerned with a peculiar dimorphism of the worker caste comparable with that observed in *Ponera eduardi.*[2] The colonies referred to *Eusphinctus* s. str. are polygynic whereas those referred to *Sphinctomyrmex* s. str. by Emery and Forel are monogynic, a difference naturally correlated with the size and development of the gaster in the females of the two groups. Since the reproductive function is distributed over several queens in *Eusphinctus,* each is more nearly of the normal stature of the largest workers than in the *Sphinctomyrmex* colony.

I therefore agree with André in leaving only *S. ståli* of Brazil in the genus *Sphinctomyrmex* and in regarding all the paleotropical species as belonging to the genus *Eusphinctus,* but believe that the latter should be divided into at least three subgenera, as follows:

1. *Eusphinctus* s. str. Workers and females with 11-jointed antennæ, with entire or emarginate pygidium, the workers blind, the females with eyes and ocelli. Habits hypogæic.
2. *Nothosphinctus* subgen. nov. Workers and females with 12-jointed antennæ; the former blind and with entire pygidium, the latter with emarginate pygidium and either blind or with very minute eyes and the anterior ocellus. Habits hypogæic.
3. *Zasphinctus* subgen. nov. Workers large, dark colored, with 12-jointed antennæ and well developed eyes, but without ocelli. Females unknown. Habits probably epigæic.

The worker of *E. cribratus* Emery of New Guinea has an entire pygidium and belongs with the Australian species in *Eusphinctus* s. str. but the workers of the Indian species *E. furcatus* Emery and *taylori* Forel have a notched pygidium. Should future investigation show that the pygidial characters are correlated with other peculiarities or with different types of female, it may be advisable to restrict the subgenus *Eusphinctus* to the two Indian species and to suggest a new subgeneric name for the Australian and Papuan forms with 11-jointed antennæ.

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[2] Cases of dimorphism of the worker among the Ponerinæ are extremely rare. The most remarkable case is that of the African *Megaponera fœtens* Fabr., which has two types of workers differing not only in size, but also in sculpture and the structure of the antennæ. As no winged females were known of this species Emery believed that their place in the colonies was usurped by the large workers but Arnold has recently discovered and described the true female (Ann. South Afr. Mus. **14**, 1915, p. 48 *nota,* Fig. 6). It is ergatoid and therefore resembles the females of *E. manni* and *imbecillis.* Among many specimens of *M. fœtens* recently collected in the Congo by Mr. H. O. Lang of the American Museum of Natural History I find both forms of worker in each colony.

In this connection attention may be called to the fact that the females of *Nothosphinctus* bear a surprising resemblance to those of the related tropical genus *Acanthostichus,* as will be seen by consulting Emery's description and figures of the female of *A. quadratus* (Zool. Jahrb. Abt. Syst. 8, 1895, p. 693, Pl. 14, Fig. 4 and Gen. Insect. Fasc. 118, 1911, Pl. 1, Figs. 4 and 4b). As Emery and Forel have remarked, these females resemble the only known females of the Dorylinæ (*Dorylus, Eciton, Aenictus, Leptanilla*) and may therefore have considerable phylogenetic significance. In previous publications I have described similar females in several Ponerine genera (*Onychomyrmex, Paranomopone, Leptogenys.*[3]

Turning to the other genera of the Cerapachyini we find that our knowledge of the females is even more incomplete than in *Sphinctomyrmex* and *Eusphinctus.* The female *Cerapachys imerinensis* Forel of Madagascar has well-developed wings and *Phyracaces pubescens* Emery of Borneo and *Ph. turneri* Forel of Queensland were described from deälated females, and I have winged females of an undescribed *Phyracaces* from the Congo, but the females of *Parasyscia augustæ* Wheeler and *Phyracaces elegans* sp. nov. show no traces of having borne wings, though the thorax is of the same structure as in the winged females. The same is true of the female of an undescribed species of *Syscia* recently taken in Fiji by Dr. W. M. Mann. In the Indian *Lioponera longitarsis* the female is ergatoid. These genera therefore exhibit various stages in the reduction of the normal winged female to the ergatoid type of *Eusphinctus* s. str. while *Nothosphinctus* may be said to show an early stage in the development of the dichthadiigyne of the Dorylinæ.

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[3] Consistency with the views here advanced would require that *Ctenopyga* Ashmead should be regarded as a distinct genus and not as a subgenus of *Acanthostichus,* since the females of the two known species, *C. texanus* Forel and *C. townsendi* Ashmead, are winged and quite different from that of *A. quadratus.* A too consistent following of the example of André and myself would, however, lead to difficulties in such cases as the European *Harpagoxenus sublævis,* an ant which in Sweden has only apterous, ergatoid females, but in Saxony has winged females of normal structure. I have perhaps overemphasized the differences between the paleotropical *Eusphinctus* and the neotropical *Sphinctomyrmex,* but my procedure may at least deter zoögeographers from citing *Sphinctomyrmex* as evidence of a former antarctic land connection between South America and Australia. It is often just such imperfectly known genera, which are confidently cited in support of ancient land-bridges; e. g. the genera *Myrmecocystus* and *Melophorus.* When carefully studied the Old World forms referred to *Myrmecocystus* are seen to be generically distinct and are now referred to *Cataglyphis,* while the South American forms referred to *Melophorus* really belong to a distinct genus, *Lasiophanes.*

The distribution of the 75 known species of Cerapachyinæ is given in the following table:

	Ethiopian	Malagasy	Indomalayan	Papuan	Australian	Hawaiian	Neotropical
Sphinctomyrmex	......	......	......	......	......	......	1
Eusphinctus	1	......	2	1	2		
Nothosphinctus	......	......	......	......	7		
Zasphinctus	......	......	......	......	1		
Cerapachys	6	1	9	2			
Parasyscia	......	......	2	......	......	......	2
Oöceraea	......	......	2				
Syscia	......	......	2	2	1	1	
Phyracaces	4	2	2	1	16		
Lioponera	2	......	2	......	1		
Total	13	3	21	6	28	1	3

It will be seen that Australia has many more species than any other region, that the genus *Phyracaces* is especially well represented and that only four of the ten genera and subgenera are absent. One of these, however, *Cerapachys* s. str., occurs in New Guinea and will therefore probably be found in Northern Queensland. The present center of distribution of the whole group, with 50 species, representing all the genera except *Sphinctomyrmex,* is seen to cover the Indomalayan, Papuan and Australian regions. That the group was once cosmopolitan in range is shown by the survival of *Sphinctomyrmex ståli* in Brazil, *Parasyscia augustæ* Wheeler in Texas and *P. tolteca* Forel in Guatemala and by the occurrence of two large primitive Cerapachyine forms (*Procerapachys annosus* Wheeler and *P. favosus* Wheeler) in the Baltic Amber.

A difference of opinion has arisen between Emery and Forel in regard to the status of *Phyracaces,* the former now regarding it as a distinct genus, the latter as a subgenus of *Cerapachys.* While the distinctive characters of *Phyracaces,* namely the less pronounced development of the terminal antennal joint, the large eyes and the sharp lateral border of the petiole and often also of the postpetiole, are minor characters, they seem to be sufficiently constant to enable one to separate the species readily from those of *Cerapachys* and its subgenera. Moreover, at least the great majority of species of *Cerapachys* sens. lat. are hypogæic, whereas those of the genus *Phyracaces* forage on the surface of the ground.

Some meager notes on *Parasyscia augustæ* which I published many years ago, have remained up to the present time the only account of the habits of a Cerapachyine ant. During my sojourn in Australia I was able to gain a few additional glimpses of the behavior of one species of *Eusphinctus* and of several species of *Phyracaces*. My brief field notes on these insects may be here transcribed:

Nov. 30, 1914, I found a fine colony of *Eusphinctus steinheili* under a large log which was rather deeply embedded in sand in the bottom of a ravine at Hornsby, New South Wales. The colony, which comprised about 200 workers and females, was crowded into a few small burrows in the sand, with a large number of nearly full-grown larvæ. Dr. Mann found three smaller colonies of this species during December, 1916, at Leura in the Blue Mts., Sydney and Wentworth Falls, N. S. W. One of these also contained adult larvæ but no pupæ.

Sept. 16, at Southerland, New South Wales, I found a colony of about 70 workers and one wingless female of *Phyracaces elegans* sp. nov. huddled together in a mass under a block of sand-stone in a thin layer of soil which in turn was lying on the hard sandstone wall of one of the deep gorges so characteristic of the country about Sydney. As there was no brood in the colony and as it had rained heavily the preceding day, I inferred that the ants were merely bivouacking after having been washed out of their nest.

Sept. 19, a fine colony of about 50 workers of *Phyracaces larvatus* sp. nov. was found under a small stone in one of the deep sandstone ravines near Katoomba in the Blue Mts. of New South Wales.

Oct. 18. Near Cairns, Queensland, I happened on about a dozen workers of *Ph. fervidus* sp. nov. running rapidly over a patch of sand in the open forest. They moved much like workers of *Lobopelta*. Two of them entered a nest of *Pheidole* but soon returned to the surface and continued foraging.

Oct. 19. A few workers of *Ph. turneri* Forel were seen running about on dead leaves in the dark, tropical "scrub" at Kuranda, Queensland. The nest was not discovered.

Oct. 25. In the same locality and also in the tropical "scrub" I found a colony of about 25 workers of *Ph. binodis* Forel in a small cavity of a damp, red-rotten log.

Nov. 10. I found several workers of *Ph. scrutator* sp. nov. foraging under a stone in a dry depression at the base of the mountain at Toowong, near Brisbane, Queensland. The ants moved rapidly and seemed to be searching for the nests of other ants.

Nov. 26. At Salisbury Court, near Uralla, New South Wales, I saw a fine colony of *Ph. senescens* sp. nov. comprising about 150 workers running rapidly about on a hill-slope, very evidently on a foraging expedition. They reminded me of the small forays of *Formica sanguinea* in northern regions.

Dec. 3. In the Bulli Pass, New South Wales I came upon a dozen workers of *Ph. ficosus* sp. nov. running over the sand in a very loose file. Three or four of them were carrying the naked pupæ of some small Myrmicine ant in their jaws.

These observations show that, as I maintained in the case of *Parasyscia augustæ*, the *Cerapachyini* form small colonies, like most species of Ponerinæ, that the species of *Eusphinctus* (with the probable exception of *S. turneri*) are hypogæic in their habits, a peculiarity also indicated by the absence of eyes in the workers of nearly all the species and the small eyes of the females, and that the large-eyed *Phyracaces* forage in troops (or as whole colonies?) on the surface of the ground, their prey consisting of the brood of other ants. These facts are very significant in connection with the affinities of the Cerapachyini to the Dorylinæ, or driver ants, which in Africa and tropical America, forage in a similar manner, though in much larger companies, because their colonies are much more populous, and also feed on the brood of other ants when other insect food is not available. Still, what I have seen are only glimpses of the habits of the Cerapachyini. Any of my fellow entomologists in Australia who will undertake an intensive study of these ants will, I am sure, find many new and interesting ethological traits and solve many problems relating to the character of the sexual phases, in addition to finding many new forms, since practically every colony of *Phyracaces* I saw, during the limited time at my disposal, represented a different, undescribed species. In addition to the material collected by myself I have been able, through the kindness of Mr. A. M. Lea, to study the Cerapachyinæ of the Museum of South Australia, comprising specimens of *Eusphinctus steinheili* and its var. *hedwigæ, Zasphinctus turneri, Phyracaces heros, leæ, rugulinodis* and *mullewanus*. Mr. Henry Hacker of the Queensland Museum has presented me with specimens of *Eusphinctus hackeri* and *Syscia australis*.

The four genera of Cerapachyini occurring in Australia may be readily distinguished as follows:

1. Gaster elongate, cylindrical, the segments separated from each other by pronounced constrictions. . . . . *Eusphinctus* Emery.
   Segments of the gaster not thus separated. . . . . 2.
2. Last antennal joint much thicker and larger than the preceding joint, forming a one-jointed club; petiole not marginate on sides *Cerapachys* F. Sm.
   Last antennal joint not enlarged, though longer than the preceding joint, and not forming a distinct club. . . . . 3.
3. Funiculus of antenna terminating in a 4-jointed club *Lioponera* Mayr.
   Funiculus not terminating in a 4-jointed club; petiole marginate on sides. . . . . *Phyracaces* Emery.

The subgenera of Cerapachys are easily distinguished by the number of antennal joints, *Cerapachys* s. str. having 12, *Parasyscia* 11, *Oöceræa* 10 and *Syscia* 9 joints.

Genus **Eusphinctus** *Emery.*

The workers and females of the subgenera, species and varieties of *Eusphinctus* may be separated by the following dichotomy:

1. Antennæ 11-jointed (Subgen. *Eusphinctus*). . . . . 2.
   Antennæ 12-jointed. . . . . 6.
2. Length 3.2–4 mm. . . . . 3.
   Length not more than 3 mm. . . . . 4.
3. At least the head, thorax and petiole ferruginous brown; sides of postpetiole straight. . . . . *steinheili* Forel.
   Color uniformly reddish; sides of postpetiole convex. var. *hedwigi* Forel.
4. Length only 1.5 mm. . . . . *hackeri* sp. nov.
   Length 2.5–3 mm. . . . . 5.
5. Pale ferruginous, head, thorax and petiole infuscated above; female with rather large, flat eyes. *steinheili* var. *duchaussoyi* Ern. André.
   Pale yellowish red; female with minute eyes. . var. *cedaris* Forel.
6. Large black species, 7–8.5 mm. long; worker with well developed eyes and emarginate pygidium (Subgen. *Zasphinctus* subgen. nov.). . . . . *turneri* Forel.
   Smaller, ferruginous or yellow species; worker eyeless or with

very minute eyes, pygidium entire (Subgen. *Nothospinctus* subgen. nov.)..7.

7. Workers with minute eyes........................*myops* Forel.
Workers without eyes..8.

8. Postpetiole concave in front......................*emeryi* Forel.
Postpetiole not concave in front............................9.

9. Head square, hardly longer than broad, thorax flattened above, marginate in front......................................10.
Head distinctly longer than broad; thorax at most submarginate in front..11

10. Mandibles punctate and coarsely striate; thorax only twice as long as broad; epinotal declivity marginate above and on the sides; petiole distinctly broader than long; head and thorax coarsely punctate..............................*froggatti* Forel.
Mandibles merely punctate; thorax 2½ times as long as broad; epinotal declivity marginate only on the sides; petiole scarcely broader than long; head and thorax finely punctate. *imbecillis* Forel.

11. Funicular joints 2–6 only slightly broader than long. *clarus* Forel.
Funicular joints 2–6 much broader than long...............12.

12. Last antennal joint scarcely longer than the two preceding joints together....................................*mjöbergi* Forel.
Last antennal joint fully as long as the three preceding joints together......................................*manni* sp. nov.

1. **Eusphinctus** (**Eusphinctus**) **steinheili** Forel.

(Figs. 1 and 2.)

Sphinctomyrmex (*Eusphinctus*) *steinheili* Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 72, ♀ (nec ☿); Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

Sphinctomyrmex steinheili Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Sphinctomyrmex (*Eusphinctus*) *fallax* Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 73 ☿; Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

Sphinctomyrmex fallax Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Worker. Length 3.2–3.6 mm.

Head nearly 1½ times as long as broad, as broad behind as in front, with very feebly convex sides, broadly excavated posterior border and short but rather pointed posterior corners. Occipital border strongly marginate, the margination running around the posterior corners and along the ventral surface on each side about $\frac{1}{3}$ the length of the head. Eyes and ocelli absent. Mandibles small, abruptly flexed at their bases, with deflected blades, the apical margins very indistinctly denticulate. Clypeus very short. Frontal carinæ closely approximated, in front surrounding the antennal insertions, behind fused and truncated in a depression which unites the antennal foveæ. Carinæ of cheeks sharp, abruptly and angularly turned inward behind towards the antennal foveæ. Antennæ robust; scapes about half as long as the head, thickened apically; first funicular joint as long as broad; joints 2–9 broader than long, apical joint enlarged, glandiform, as long as the four preceding joints together. Thorax about $2\frac{1}{2}$ times as long as broad, its dorsal surface flattened, with a very feeble transverse depression marking the obsolete mesoëpinotal suture; epinotum abruptly truncated behind, distinctly concave in profile; pronotum marginate in front; epinotal declivity sharply marginate on the sides and above, on each side above very feebly subdentate. Mesopleuræ rather concave. Petiole from above rectangular, distinctly longer than broad, scarcely broader behind than in front, narrower than the epinotum, with straight, subparallel sides, rather rounded, convex dorsal surface and a sharp, angular tooth, directed forward and downward on its anteroventral surface. Postpetiole broader than the petiole, as long as broad and distinctly broader behind than in front, with straight sides and anterior border, its ventral portion in front

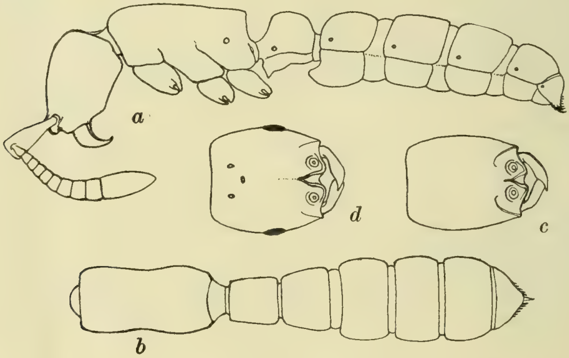

FIGURE 1. *Eusphinctus steinheili* Forel, *a*, worker in profile; *b*, thorax and abdomen of same, dorsal view; *c*, head of same, *d*, head of female.

very protuberant and rounded. First gastric segment $1\frac{1}{2}$, second and third segments twice as broad as long. Pygidium subtruncate behind, on each side and at the blunt tip minutely spinulate. Legs moderately long.

Shining; mandibles coarsely punctate; head, thorax and petiole covered with rather shallow, umbilicate, piligerous foveolæ, which are dense on the head and distinctly sparser on the thorax and petiole. Postpetiole and gaster evenly punctate.

Hairs pale yellow, slender, pointed, moderately long, suberect on the body, partly appressed and like long pubescence on the gaster. Antennæ and legs with very few erect hairs, but covered with rather abundant, appressed pubescence.

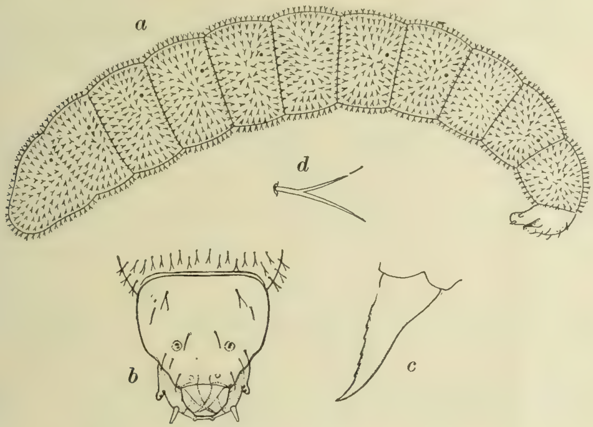

FIGURE 2. *a*, Larva of *Eusphinctus steinheili* Forel, lateral view. *b*, head of same, dorsal view; *c*, mandible; *d*, forked hair from body enlarged.

Ferruginous brown; mandibles, cheeks, antennæ, legs, postpetiole and gaster paler and more reddish.

Female. Length 3.5–4 mm.

Differing from the worker in its large side, in the proportionally broader head, which is scarcely $1\frac{1}{4}$ times as long as broad, the less distinct carinæ on the cheeks and the presence of eyes and ocelli, the eyes being moderately large, rather flat and placed a little in front of the middle of the sides of the head. The petiole is not longer than broad, the gaster more voluminous, with the constrictions between the segments less pronounced than in the worker. The erect hairs on the body and appendages are longer, more abundant and more bristly, even on the antennal funiculi. The appressed hairs on the gaster are also longer and more numerous.

Larva. Long and slender, cylindrical and not enlarged at the posterior end, with eleven distinct postcephalic segments, all uniformly clothed with short, erect, two-branched hairs. Head small, as broad as long, with vestigial antennæ and long falcate mandibles, which have finely serrate internal borders. There are few hairs on the head and these are simple, with the exception of a pair near the occipital border, which are two-branches like those on the body. The color of the larva is dull white.

Queensland: Mackay, type-locality (Turner).

New South Wales: Hornsby (Wheeler); Sydney, Wentworth Falls and Leura, Blue Mts. (W. M. Mann).

South Australia: Lucindale (Feuerheerdt).

I have examined a cotype of *steinheili* given me by Prof. Forel. It is indistinguishable from the females in the colonies I have seen from New South Wales and South Australia, the workers of which are evidently referable to Forel's *fallax*. The nests are found in sand under logs and stones.

2. **Eusphinctus** (**Eusphinctus**) **steinheili** var. **hedwigæ** Forel.

Sphinctomyrmex (*Eusphinctus*) *fallax* subsp. *hedwigæ* Forel, Rev. Suisse Zool. 18, 1910, p. 21 ☿ ♀; Emery, Gen. Insect. Fasc. 118, 1911, p. 7; Boll. Lab. Zool. Gen. Agrar. 8, 1914, p. 179.

Sphinctomyrmex hednigæ (sic!) Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

New South Wales: Walcha, type locality (W. W. Froggatt).

South Australia: Mt. Lofty (Silvestri; A. M. Lea); Adelaide (Mus. S. Austr.).

I am convinced from examination of a cotype worker and female and of many specimens of both phases from the two localities in South Australia that this is merely a variety of *steinheili*. The postpetiole has the sides more rounded in the worker than in the typical form of the species, but both this character and the width of the gastric segments of the two forms are somewhat variable, so that often they can be distinguished only by the coloration, *hedwigæ* having the body more uniformly reddish.

3. **Eusphinctus** (**Eusphinctus**) **steinheili** var. **duchaussoyi** Ern. André.

Eusphinctus duchaussoyi Ern. André, Rev. d'Ent., 1909, p. 205, ☿ ♀.

Sphinctomyrmex (*Eusphinctus*) *duchaussoyi* Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

New South Wales: Sydney (A. Duchaussoy).

Judging from André's description this form, too, is hardly more than a variety of *steinheili*. It is distinctly smaller, the worker measuring only 2.5–3 mm., the female 2.7–3 mm. The color is paler as in *hedwigæ* and the punctures are different, being described as sparse and a little larger and less abundant on the head and thorax and finer and denser on the abdomen.

4. **Eusphinctus** (**Eusphinctus**) **steinheili** var. **cedaris** Forel.

Sphinctomyrmex (*Eusphinctus*) *fallax* var. *cedaris* Forel, Ark. f. Zool. 9, 1915, p. 16, ☿ ♀.

Queensland: Cedar Creek (E. Mjöberg).

Of about the same size as *duchaussoyi*, the worker measuring 2.5–2.6 mm., the female 2.9 to 3.1 mm. The petiole of the worker is more steeply truncate in front below than in *steinheili*, the punctures are sharper and denser on the abdomen, but feebler and sparser on the head. In the female the eyes are smaller, consisting of only about 8 or 9 indistinct facets.

5. **Eusphinctus** (**Eusphinctus**) **hackeri** sp. nov.

(Fig. 3.)

Worker. Length 1.5–1.7 mm.

Head rectangular, fully 1½ times as long as broad, as broad behind as in front, with straight, parallel sides, rather deeply excised posterior border and short, blunt posterior corners. Occipital border marginate. Eyes and ocelli absent. Mandibles not abruptly flexed at the base, their apical and basal borders not distinctly separated, the former minutely denticulate. Frontal carinæ approximated, surrounding the antennal insertions in front, confluent behind and truncated in a depression connecting the antennal foveæ. Carinæ of cheeks short and indistinct. Antennæ robust; scapes about ⅓ as long as the head, much thickened apically, first funicular joint as long as broad, joints 2–9 very transverse, terminal joint large, glandiform, fully as long as the five preceding joints together. Thorax about 2½ times as long as broad, with flattened dorsum, rounded humeri and epinotal angles, as broad behind as in front, with very feebly indicated mesoëpinotal suture. Pronotum not marginate, epinotal declivity marginate only on the sides, in profile truncated and decidedly concave. Petiole narrower than the epinotum, rectangular, a little longer than broad and a little broader behind than in front, its dorsal surface convex, its anteroventral surface with a small, acute tooth. Postpetiole rectangular, broader than the petiole, as broad as long, a little broader behind than in front, with straight sides. Gastric segments 1–3 nearly twice as broad as long. Pygidium short, broadly rounded and truncate behind, where it is bordered with minute spinules.

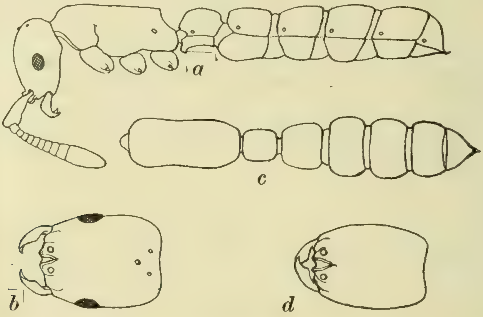

FIGURE 3. *a*, Female *Eusphinctus hackeri* sp. nov., lateral view; *b*, head of same, dorsal view; *c*, thorax and abdomen of worker, dorsal view; *d*, head of same.

Shining; mandibles coarsely punctate; head, thorax, petiole and postpetiole covered with umbilicate, piligerous foveolæ, which are densest on the upper surface of the head, elongate on its front and sides; gaster rather coarsely and evenly punctate. Antennal scapes sparsely foveolate.

Hairs pale yellow, short, erect, moderately abundant, longer at the tip of the gaster; pubescence dilute. Legs with fine, dilute, appressed pubescence and a very few, erect hairs.

Uniformly brownish yellow, not infuscated.

Female. Length 1.8 to 2 mm.

Differing from the worker in size and in having eyes and ocelli, the former distinctly in front of the middle of the head, the broader and more rounded petiole and more voluminous gaster, with less pronounced constrictions between the segments. The sides of the postpetiole are straight as in the worker. The erect hairs on both the body and appendages are distinctly more abundant and more bristly.

Described from six workers and two females taken by Mr. Henry Hacker on Bribie Island, near Brisbane, Queensland.

This species is easily recognized by its very small size, rounded humeri and epinotal corners and the absence of marginations on the pronotum and upper portion of the epinotal declivity.

6. **Eusphinctus (Zasphinctus) turneri** Forel.

(Fig. 4.)

Sphinctomyrmex turneri Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 70, ☿; Rev. Suisse Zool. 18, 1910, p. 21, ☿; Froggatt, Agric. Gaz. N. S. W., 1905, p. 15; Emery, Gen. Insect. Fasc. 118, 1911, p. 7, Pl. 1, Fig. 1, ☿.

Worker. Length 7–8.5 mm.

Head subrectangular, a little longer than broad, as broad in front as behind, broadest through the eyes, which are moderately large and convex and a little in front of the middle of the sides; occipital border deeply and broadly excavated, marginate, the margin surrounding the posterior corners and extending forward on the gular surface about $\frac{1}{3}$ the length of the head. Ocelli absent. Carinæ of cheeks distinct but not dentate, running backward and inward towards the antennal foveæ. Mandibles rather small, subtriangular, deflected, their apical margins indistinctly denticulate. Clypeus short, with straight anterior border. Frontal carinæ short, erect, rounded, approximated and strongly truncated behind, surrounding the antennal insertions in front. Antennæ rather long, 12-jointed; scapes about $\frac{2}{3}$ as long as the head; funicular joints 1 and 5–10 distinctly broader than long, joints 2–4 as long as broad, terminal joint but slightly enlarged, as long as the three preceding joints. Thorax less than twice as long as broad, a little broader behind than in front, with rounded anterior and posterior corners, marginate anterior and prosternal borders, very feebly convex dorsal and slightly concave mesopleural surfaces, without promesonotal or mesoëpinotal sutures. The truncated surface of the epinotum is surrounded above and on the sides by a sharp margination. Petiole as long as broad, rounded-cuboidal, slightly broader behind than in front, distinctly narrower than the epinotum, in profile higher than long, rounded above, with vertical, truncated anterior and posterior surfaces and a powerful triangular tooth at the anteroventral end. Postpetiole broader than the petiole, a little broader behind than in front, with rectangular anterior corners, convex dorsal surface and its anterior ventral portion rounded and strongly protuberant. Gastric segments 1–3 broader than long, separated by very deep and broad constrictions. Pygidium trapezoidal, flattened or slightly concave above, submarginate on the sides and rather deeply notched at the tip, the sides and notch fringed with conspicuous spinules. Sting robust, curved. Legs rather long, posterior coxæ without lamellate appendages.

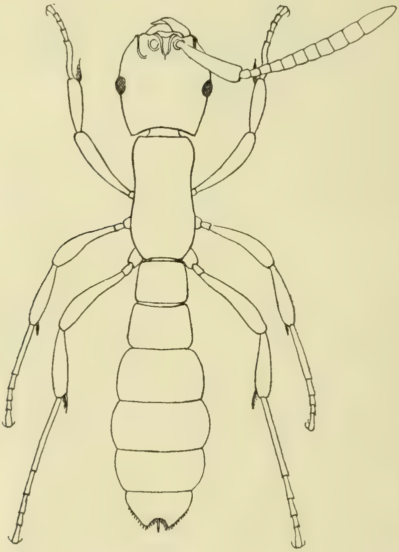

FIGURE 4. *Zasphinctus turneri* Forel. Worker.

Opaque; mandibles shining, coarsely punctate; head and thorax covered with round foveolæ, varying in size, their bottoms opaque and finely rugulose. These foveolæ are so close together that the spaces between them form coarse but not prominent reticulate rugæ. Remainder of body, including the legs and scapes coarsely and densely punctate. Epinotal declivity shining, very finely and transversely shagreened.

Hairs grayish yellow, abundant and rather long, in part suberect, both on the body and appendages, and in part appressed, the latter appearing on the appendages as long pubescence.

Black; tarsi, articulations of legs, antennal funiculi, mandibles, clypeus, frontal carinæ, cheeks and pygidium reddish.

Queensland: Mackay, type-locality (Gilbert Turner); Kuranda (Rowland Turner and F. P. Dodd).

I have redescribed this species from four specimens from Kuranda, two received from Prof. Forel and taken by Rowland Turner and two taken by F. P. Dodd and belonging to the Museum of South Australia.

E. turneri is readily recognized by its large size, black color, the presence of eyes and the emarginate pygidium.

7. **Eusphinctus (Nothosphinctus) froggatti** Forel.

(Fig. 5.)

Sphinctomyrmex froggatti Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 71, ☿; Froggatt, Agric. Gaz. N. S. W., 1905, p. 15; Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

Worker. Length 4.5–5.5 mm.

Head nearly square when seen from above, scarcely longer than broad, as broad in front as behind, with feebly rounded sides, deeply excavated posterior border and sharp posterior corners. Margination of posterior border and corners continued forward on each side of the gula fully $\frac{2}{3}$ the length of the head. Mandibles strongly flexed inward at the base, with distinctly concave external border, the apical border denticulate and passing through a curve into the basal border. Clypeus very short, its anterior border broadly rounded. Frontal carinæ very short, erect, small, approximated, fused and strongly truncated behind and curving around the antennal insertions in front. Antennal foveæ confluent behind the frontal carinæ. Cheeks with small, indistinct carinæ, which border the antennal insertions on the sides. Antennæ short and stout; scapes about half as long as the head, thickened towards their tips; funicular joints 1–9 short, very distinctly broader than long, tenth joint as broad as long, terminal joint fully as long as the three preceding joints together. Thorax subrectangular, fully twice as long as broad, as broad through the pronotum as through the epinotum, with blunt anterior and posterior corners, flattened above and on the sides, which are scarcely submarginate, with sloping, concave, epinotal declivity. Mesoëpinotal suture very feebly indicated. Pronotum in front, prosterna, sides and upper border of epinotal declivity marginate. Petiole rounded cuboidal, as long as high, a little broader than long and a little broader behind than in front, its anterior surface flat and marginate on the sides; its ventral surface in front with a large, blunt, compressed tooth. Postpetiole fully $1\frac{2}{3}$ times as broad as long, broader than the petiole, broader behind than in front, with rounded anterior angles, and its ventral portion in front swollen and strongly protuberant. Pygidium flattened above, entire and blunt at the tip, with a row of spinules along each side. Legs moderately long; hind coxæ without lamellate appendage at the tip.

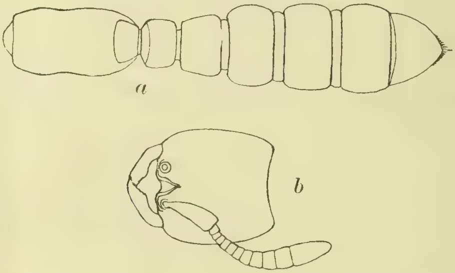

FIGURE 5. *a, Nothosphinctus froggatti* Forel, thorax and abdomen of worker, dorsal view; *b*, head of same.

Shining; mandibles coarsely punctate, striate at the base; head, thorax, petiole and postpetiole covered with scattered foveolæ of varying size, denser on the head, very sparse in the mid-dorsal line of the thorax and on the petiole and postpetiole; gaster very finely shagreened and sparsely punctate.

Hairs pale yellow, short, moderately abundant, oblique or subappressed, shorter and more appressed on the appendages where they may be described as long; pubescence rather abundant, especially on the tibiæ.

Brownish red; scapes and legs somewhat paler; mandibles, anterior border of head and incisures of funicular joints blackish.

New South Wales: Minto, type locality (W. W. Froggatt); Sydney (A. M. Lea).

Redescribed from four specimens from the latter locality (Museum of South Australia).

8. **Eusphinctus (Nothosphinctus) emeryi** Forel.

Cerapachys emeryi Forel, Ann. Soc. Ent. Belg. 37, 1893, p. 461, ☿.

Sphinctomyrmex emeryi Froggatt, Agric. Gaz. N. S. W. 1905, p. 15; Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

North West Australia: Baudin Island (J. J. Walker).

9. **Eusphinctus (Nothosphinctus) myops** Forel.

Sphinctomyrmex emeryi var. *myops* Forel, Ann. Soc. Ent. Belg. 39, 1895, p. 421 ☿; Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

S. emeryi race *clarus* var. *myops* Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Queensland: Mackay (Gilbert Turner).

Forel does not state whether he regards the type as a normal or a gynæcoid worker. It may be the female of *emeryi*, or of an allied form, but if it is a normal worker, it should rank as a distinct species, since *emeryi* is eyeless. His brief description runs as follows: "Sculpture that of the type [*emeryi*]. Form and pilosity those of the race *clarus*. Color intermediate. Distinct from the two forms in possessing very small but distinct, flattened eyes situated at the middle of the sides of the head and comprising some thirty facets."

10. **Eusphinctus (Nothosphinctus) clarus** Forel.

Cerapachys emeryi var. *clarus* Forel, Ann. Soc. Ent. Belg. 37, 1893, p. 462, ☿.

Cerapachys clarus Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 72, ☿.

Sphinctomyrmex emeryi race *clarus* Forel, Rev. Suisse Zool. 10, 1902, p. 537; Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Sphinctomyrmex clarus Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

North West Australia: Adelaide River (J. J. Walker).

11. **Eusphinctus (Nothosphinctus) imbecillis** Forel.

Sphinctomyrmex froggatti subsp. *imbecillis* Forel, Fauna S. W. Austr. 1, 1907, p. 272, ☿, erg. ♀; Emery, Gen. Insect. Fasc. 118, 1911, p. 7.

South West Australia: Lion Mill.

I believe this form must be regarded as a distinct species as the characters in which it differs from *clarus*, are, according to Forel's statement, more than subspecific. The mandibles are not striated as in *froggatti* and are less geniculate at their bases, the anterior corners of the pronotum are more rounded, the thorax longer, the epinotum not marginate above, the petiole hardly broader than long, with shorter ventral tooth and the puncturation is feebler and sparser than in *froggatti*.

The "ergatomorphic female," described by Forel, is eyeless, with swollen epinotum, shorter and more rounded head, the petiole 1⅓ times as broad as long, more voluminous gaster, emarginate pygidium, and the surface is more opaque, more punctate and more pubescent than in the worker. This singular individual measured 6.5 mm. It was found in the same vial with a number of workers and undoubtedly belonged to the same species. Forel believes that such individuals must represent the type from which the dichthadiiform females of the Dorylinæ have developed.

12. **Eusphinctus** (**Nothosphinctus**) **manni** sp. nov.

(Fig. 6.)

Worker. Length 3–5 mm.

Head distinctly longer than broad, a little broader in front than behind, with evenly rounded sides, feebly and broadly concave occipital border and short, blunt posterior corners. Eyes and ocelli absent. Occipital border marginate, the margination surrounding the posterior corners. Carinæ of cheeks very feebly developed. Mandibles not geniculate nor abruptly curved at the base, their apical borders finely denticulate. Frontal carinæ short, erect, surrounding the antennal insertions in front, truncated and fused behind in a depression uniting the antennal foveæ. Antennæ rather slender; scapes less than half as long as the head, thick at the apex, rather suddenly narrowed at the basal fourth; funicular joints 2–9 much broader than long, tenth joint as long as broad, terminal joint rather slender, fully as long as the three preceding joints together. Thorax fully 2½ times as long as broad, distinctly narrowed in the mesonotal region, flattened above, submarginate on the sides; pronotum with rectangular humeri, vertically truncated and submarginate in front, the mesoëpinotal suture indicated by a feeble impression; epinotal declivity steep, slightly concave, its sides sharply, its upper border feebly but distinctly marginate. Petiole subcuboidal, narrower than the epinotum, slightly broader than long, distinctly broader behind than in front, its anterior surface truncated and flat, marginate on the sides and submarginate above, its ventral surface in front with a large, blunt, compressed, translucent tooth. Postpetiole broader than the petiole, about $\frac{1}{3}$ broader than long and broader behind than in front, its anterior and lateral borders straight, its anterior corners rounded, its posterior border feebly concave in the middle. Gastric segments 1–3 twice as broad as long, separated by pronounced constrictions. Pygidium truncated behind, with blunt, entire border, scarcely submarginate on the sides, the posterior border densely spinulate. Legs moderately long.

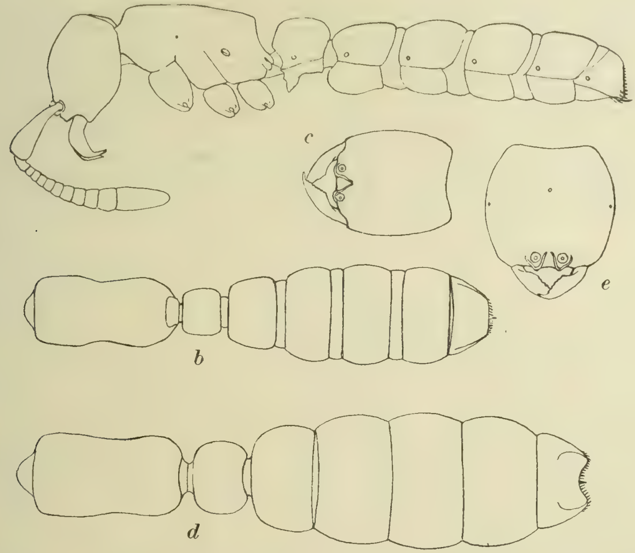

FIGURE 6. *a, Nothosphinctus manni* sp. nov. Worker, lateral view; *b,* thorax and abdomen of same, dorsal view; *c,* head of same; *d,* thorax and abdomen of female; *e,* head of same.

Shining; mandibles subopaque, coarsely punctate, body finely and unevenly punctate, the punctures denser on the head and legs, not larger on the thorax than on the gaster.

Hairs short, yellow, appressed or subappressed, longest on the gaster, especially at its tip. Tibiæ and gaster with a few suberect, delicate hairs.

Uniformly brownish yellow; mandibles, frontal carinæ and incisures of antennal joints fuscous.

Female. Length 7 mm.

Very similar to the worker but besides its larger size differing in the following characters: Head not longer than broad, with much more convex sides. Posterior ocelli absent; eyes and the anterior ocellus present but the former very small, reduced to three or four minute ommatidia. Thorax shorter and stouter, not more than twice as long as broad, pronotum and lateral borders not submarginate and margination of epinotum indistinct. Petiole as broad as the epinotum, broader in proportion to its length than in the worker, flattened above, its posterior border broadly concave in the middle, its anterior surface not submarginate. Postpetiole and gaster larger, the incisures between the segments of the latter much less pronounced than in the worker, the postpetiole flattened above, nearly twice as broad as long, as are also the three basal gastric segments. Pygidium broadly and rather deeply excised behind, its posterior surface truncated, with almost submarginate sides, the posterior excision beset with minute spinules. Sting short and stout.

Sculpture like that of the worker, the surface being quite as shining; the thorax and abdomen with fine punctures and in addition with large, scattered, shallow foveolæ.

Hairs much more abundant than in the worker, erect and bristly, conspicuous also on the appendages. Pubescence abundant and rather dense, especially on the head and gaster.

Color like that of the worker, but the mandibles are ferruginous red with their apical and basal borders black. Sting black.

Described from numerous workers and a single female taken from the same colony in December 1916 at Leura in the Blue Mts. of New South Wales by Dr. W. M. Mann.

This form is very close to *imbecillis* Forel, but the female and largest workers are larger and the former possesses small eyes and has a shining body like the worker, the pronotum has more pronounced corners, the epinotal declivity of the worker is distinctly marginate above, the petiole is broader, and both the large and small workers have the same pale coloration. Additional material may show that *manni* is to be regarded as a subspecies of *imbecillis*.

13. **Eusphinctus (Nothosphinctus) mjöbergi** Forel.

Sphinctomyrmex clarus subsp. *mjöbergi* Forel, Ark. f. Zool. 9, 1915, p. 16, ☿.

Queensland: Mt. Tambourine (E. Mjöberg).

This form, too, I believe, should be regarded as a distinct species, as the differences which, according to Forel, separate it from *clarus* and *emeryi* are considerable. It is much larger (5.2–5.3 mm.) than *clarus*, much stouter and of a much darker color, and the antennæ are very different, the scapes being longer and more gradually thickened towards their tips, funicular joints 2–6 are much more transverse and the terminal joint is shorter. The thorax and petiole are more convex than in *emeryi* and the petiole is not concave in front nor marginate above, the postpetiole is longer, the first gastric segment much broader, the gastric constrictions are less pronounced, the puncturation of the body is sparser, the pubescence more dilute and the color paler, brownish red.

Genus **Phyracaces** *Emery.*

Table for the Identification of the Workers.

1. Body entirely or partly red.......................................2.
   Body black, at most with cheeks, front, pygidium and appendages red.......................................13.
2. Large species, measuring 9 mm.; petiole narrowed and bilobed behind.......................................*heros* sp. nov.
   Smaller species, not exceeding 7 mm.; petiole rectangular, toothed at posterior corners.......................................3.
3. Black, with red gaster.......................................*ficosus* sp. nov.
   At least the head red.......................................4.
4. Abdomen black or dark brown.......................................5.
   Body red throughout.......................................6.
5. Head and thorax red. Length 6–6.2 mm. *singularis* Forel subsp. *rotula* Forel.
   Thorax more or less blackened. Length 3–3.5 mm. *elegans* sp. nov.
6. Head, thorax and pedicel subopaque. Length 3.6–4 mm. *scrutator* sp. nov.
   Body shining.......................................7.

7. Postorbital carinæ present . . . . 8.
Postorbital carinæ absent . . . . 10.
8. Epinotal declivity longitudinally rugose . . . . *jovis* Forel.
Epinotal declivity smooth . . . . 9.
9. Head feebly excised behind. Length 7 mm. . . *singularis* Forel.
Head deeply excised behind. Length 6 mm. . . . . *mjöbergi* Forel.
10. Length 6–7 mm. . . . . 11.
Length not exceeding 5 mm. . . . . 12.
11. Eyes at middle of head; antennal scapes separated only by their own width from occipital border . . . . *sjöstedti* Forel.
Eyes a little behind the middle of the head; scapes reaching only to middle of eyes . . . . *emeryi* Viehmeyer.
12. Thorax distinctly narrowed in middle; body very shining. Length 5 mm. . . . . *leæ* sp. nov.
Thorax scarcely narrowed in middle, body more sharply shagreened and less shining. Length 3.8–4.2 mm. *fervidus* sp. nov.
13. Petiole, postpetiole and gaster with conspicuous appressed hairs besides the suberect hairs . . . . *senescens* sp. nov.
Petiole, postpetiole and gaster with suberect hairs only. . . . . 14.
14. Postpetiole scarcely larger than the petiole, as long as broad. *binodis* Forel.
Postpetiole larger than the petiole . . . . 15.
15. Eyes large, as long as distance between them and anterior border of head . . . . *adami* Forel.
Eyes distinctly smaller . . . . 16.
16. Cheeks red; funicular joints 2–9 broader than long. *larvatus* sp. nov.
Cheeks black; funicular joints 2–9 as broad as long. *turneri* Forel.

14. **Phyracaces heros** sp. nov.

(Fig. 7.)

Worker. Length 9 mm.

Head distinctly longer than broad and distinctly narrower in front than behind, with rather deeply and angularly excised posterior border, acute inferoposterior corners and rather large, convex eyes at the middle of the sides. Ocelli present, but small. Mandibles triangular, strongly deflected, with distinct apical and basal borders meeting at a rounded angle, the former finely denticulate, the external borders nearly straight. Clypeus very short, vertical, fused with the front. Frontal carinæ large, erect, rounded, truncated and confluent behind. Frontal groove short but distinct. Carina of cheeks bluntly dentate in front, curving inward behind and ending half way between the eye and antennal insertion. Posterior border of head marginate, the margination at the posteroinferior corner sending a horizontal carina forward nearly to the eye and another ridge downward and forward along the lateral surface of the gula half way to the anterior border of the head. Antennæ rather long and slender; scapes more than half as long as the head, slender at the base, gradually enlarging towards their tips; first funicular joint a little longer than broad, second twice and third nearly twice as long as broad; remaining joints 1½ times as long as broad, except the last which is slender and pointed, twice as long as broad and not longer than the two preceding joints together. Thorax through the pronotum narrower than the head and the epinotum, narrowed in the mesonotal region, in profile evenly rounded and rather convex above to the epinotal declivity which is straight and sloping. Pleuræ concave. Anterior border, sides of thoracic dorsum and of epinotal declivity strongly marginate. Boundary between base and declivity of epinotum feebly marginate; corners of epinotum bluntly dentate. Petiole a little broader than the epinotum, a little broader than long, decidedly narrower behind than in front, with straight anterior and convex lateral borders, its posterior border deeply excised in the middle, with a flattened, rounded lobe at each corner. The whole border is marginate except in the middle behind. In profile the upper surface of the petiole is flattened, its anterior surface abrupt and truncate, forming a right angle with the dorsal surface and longer

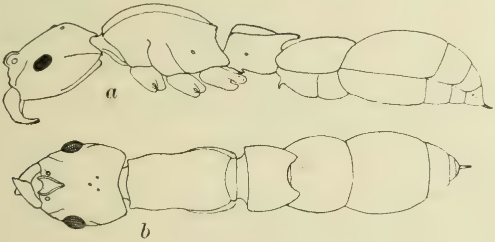

FIGURE 7. *Phyracaces heros* sp. nov. Worker; *a*, lateral view of body; *b*, dorsal view.

than the similar posterior surface. The ventral surface bears in front a thick, backwardly directed tooth. Postpetiole broader than the petiole, convex above and on the sides, a little broader than long, with marginate sides and a small, flattened tooth on the front of the ventral surface. First gastric segment scarcely broader than the postpetiole and of a similar shape. Pygidium with a narrow, median, longitudinal impression in front, its sides indistinctly marginate and spinulose. Legs rather long and slender; claws nearly straight; hind coxæ with a large rounded, translucent lamella at the tip on the inner side.

Surface of body smooth and shining. Mandibles coarsely punctate. Sides of front punctate-rugulose. Upper surface of body with very sparse, coarse, piligerous punctures; legs with finer and more numerous punctures. Sides of pygidium finely and densely punctate.

Hairs moderately abundant, coarse, bristly, erect, grayish or yellowish in some lights, blackish in others, long on the gaster, especially at its tip, shorter and sparser on other parts of the body, quite as long, erect and abundant on the legs and antennæ as on the head, thorax and petiole. Pubescence absent.

Rich red throughout, appendages not paler.

Described from a single example taken in Queensland (Mus. South Austr.).

This handsome species is readily distinguished by its large size, the shape of the antennæ and petiole, peculiar pilosity, etc.

15. **Phyracaces singularis** Forel.

Cerapachys singularis Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 69. ☿; Froggatt, Agric. Gaz. N. S. W., 1905, p. 14.

Phyracaces singularis Emery, Gen. Insect. Fasc. 118, 1911, p. 11.

South Australia (Wroughton).

16. **Phyracaces singularis** Forel subsp. **rotula** Forel.

Cerapachys (*Phyracaces*) *singularis* Forel race *rotula* Forel, Rev. Suisse Zool., 18, 1910, p. 21, ☿.

Cerapachys singularis var. *ratula* (sic!) Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Phyracaces singularis var. *rotula* Emery, Gen. Insect. Fasc. 118, 1911, p. 11.

New South Wales: Inverall (W. W. Froggatt).

17. **Phyracaces emeryi** Viehmeyer.

Viehmeyer, Arch. f. Naturg. 79, 1913, p. 26, ☿.
South Australia: Killalpaninna.

18. **Phyracaces mjöbergi** Forel.

Cerapachys (*Phyracaces*) *mjöbergi* Forel, Ark. f. Zool. 9, 1915, p. 18, Pl. 1, Fig. 9, ☿.
North West Australia: Derby (E. Mjöberg).

19. **Phyracaces sjöstedti** Forel.

Cerapachys (*Phyracaces*) *sjöstedti* Forel, Ark. f. Zool. 9, 1915, p. 19, Pl. 1, Fig. 6, ☿.
North West Australia (E. Mjöberg).

20. **Phyracaces jovis** Forel.

Cerapachys (*Phyracaces*) *jovis* Forel, Ark. f. Zool. 9, 1915, p. 20, Pl. 1, Fig. 1, ☿.
Queensland: Alice River (E. Mjöberg).

21. **Phyracaces leæ** sp. nov.

(Fig. 8.)

Worker. Length 5 mm.

Head longer than broad, slightly narrower in front than behind, with truncated occipital surface, deeply and angularly excised posterior border and acute inferoposterior angles. Eyes rather large, moderately convex, just in front of the middle of the sides. Carinæ of cheeks forming acute angles in front, extending back to the anterior orbits and sending a branch inward to the antennal fossa. Postocular carina absent. Occipital border of head marginate, the margin surrounding the inferoposterior corners and extending forward as a pair of gular carinæ to the level of the middle of the eyes. Mandibles moderately large, triangular, deflected, their external borders concave, their apical borders without denticles. Frontal carinæ approximated, rounded, erect, not truncated behind where they fuse and join the short frontal furrow. Clypeus very short, vertical, with straight anterior border. Antennæ moderately thick; scapes a little more than half as long as the head, gradually incrassated towards their tips; first funicular joint nearly as long as broad, joints 2–9 broader than long, tenth joint as long as broad, terminal joint not longer than the two preceding joints together. Thorax rather robust, twice as long as broad, a little broader through the epinotum than through the pronotum, distinctly narrowed in the mesonotal region. Anterior border of pronotum not marginate; sides of dorsum, boundary between the epinotal base and declivity and the sides of the latter strongly marginate. In profile the dorsum is feebly convex, the epinotal declivity straight, with a small tooth above on each side. Petiole rectangular, a little broader than long, its sides straight, strongly marginate, produced behind as a pair of flat, acute teeth, its anterior border broadly concave, its anterior corners slightly rounded; in profile the dorsal surface is rather convex, its ventral surface without a tooth. Postpetiole rectangular, slightly broader than the petiole and slightly broader than long, its rounded anterior angles alone marginate. First gastric segment distinctly broader than the postpetiole, broader than long. Pygidium broadly concave above, its sides marginate and finely spinulate. Legs rather long; hind coxæ with a large, rounded, translucent lamella at the tip on the inner side.

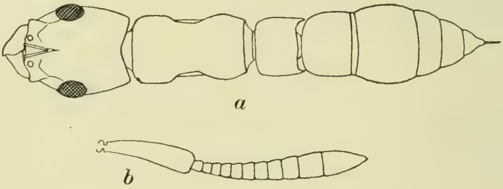

FIGURE 8. *Phyracaces leæ* sp. nov. Worker, *a*, dorsal view of body; *b*, antenna of same.

Smooth and shining, the head and thorax very finely and superficially shagreened; mandibles more coarsely shagreened and sparsely punctate. Occipital region and upper surface of thorax and abdomen with scattered, shallow, piligerous foveolæ.

Hairs pale yellow, suberect, short, sparse and rather bristly, sparsest on the head, scapes and legs. Pubescence pale, dilute, distinct only on the legs.

Rich red throughout, antennal scapes paler, apical margins of mandibles and marginations of the head, thorax and petiole blackish.

Described from a single example taken by Mr. F. P. Dodd at Townsville, Queensland (Museum of South Australia).

This beautiful species, which is dedicated to Mr. A. M. Lea, resembles *Ph. fervidus,* but is distinctly larger, even more shining and has a differently shaped thorax.

22. **Phyracaces fervidus** sp. nov.

(Fig. 9.)

Worker. Length 3.8–4.2 mm.

Head longer than broad, distinctly broader behind than in front, with truncated occipital region and rather large, moderately convex eyes, situated at the anterior $\frac{2}{5}$ of the sides. Mandibles rather large, triangular, deflected, with concave external and edentate apical borders. Clypeus very short, vertical, broadly rounded in front; frontal carinæ approximated, not truncate behind where they unite and join the short frontal furrow. Carina of cheeks very prominent, forming a projecting tooth and dividing behind to form two ridges, one of which runs to the anterior orbit, the other to the antennal fovea. Postocular carina absent. Occipital border of head deeply and subangularly excised and marginate, the margination surrounding the rather acute inferoposterior corners and extending forward on the sides of the gula to the level of the middle of the eyes. Antennæ rather slender; scapes about half as long as the head, gradually incrassated towards their tips, first and second funicular joints as long as broad; joints 3–9 distinctly broader than long; tenth joint as long as broad, terminal joint nearly as long as the three preceding joints together. Thorax rather robust; twice as long as broad, as broad in

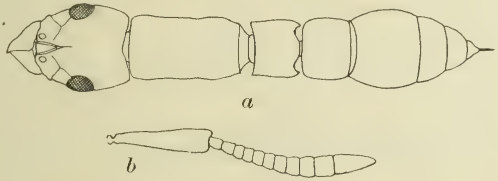

FIGURE 9. *Phyracaces fervidus* sp. nov. Worker, *a,* dorsal view of body; *c,* antenna of same.

front as behind, very feebly narrowed in the mesonotal region. Anterior border, sides and boundary between base and declivity of epinotum sharply marginate, as are also the prosterna and the sides of the epinotal declivity. In profile the thoracic dorsum is feebly and evenly convex, the declivity abrupt and nearly straight, the mesopleuræ slightly concave. Petiole a little narrower than the epinotum, rectangular, broader than long, not broader behind than in front, its anterior border broadly excised, submarginate, the sides rather straight, strongly marginate and terminating behind in a pair of flat, pointed teeth. In profile the dorsal surface is feebly convex, as are also the truncated anterior and posterior surfaces; lower surface in front with a small, acute backwardly directed tooth. Postpetiole rectangular, a little broader than the petiole and slightly broader than long, the anterior border and anterior corners scarcely submarginate. First gastric segment decidedly broader than the postpetiole, broader than long, with broadly concave anterior border and convex sides. Pygidium broadly concave above, marginate and very finely spinulate on the sides. Legs rather long, hind coxæ with a large, rounded, translucent lamella at the tip on the inner side.

Shining; finely but distinctly shagreened, the head, thorax, petiole and postpetiole more sharply so that these parts are a little less shining than the gaster. Mandibles sparsely punctate, the occiput, dorsum of thorax and abdomen with sparse, shallow, piligerous foveolæ.

Hairs yellow, suberect, delicate, moderately long and abundant on the upper surface of the thorax and abdomen, sparser on the head, very sparse on the legs and scapes. Pubescence long and conspicuous on the legs, especially on the tibiæ and on the ventral surface of the petiole.

Uniformly red, of the tint of *Polyergus rufescens*, apical borders of mandibles and carinæ of head, thorax and petiole of a deeper color, almost blackish.

Described from 19 specimens taken Oct. 18, 1914 at Cairns, Queensland, foraging on a sandy spot in the forest.

This species resembles *Ph. scrutator* but differs in being slightly larger, with more robust thorax and in having the head, thorax, petiole and postpetiole shining, the pilosity more delicate and the pubescence much longer and more abundant on the legs.

23. **Phyracaces scrutator** sp. nov.

(Fig. 10.)

Worker. Length 3.6–4 mm.

Head decidedly longer than broad, slightly narrower in front than behind, with feebly rounded sides, deeply and angularly excised occipital border and truncated occipital surface, with the inferoposterior angles sharp when seen from behind. Eyes large and rather convex, slightly in front of the middle. Ocelli absent. Mandibles rather large and broad, triangular, deflected, their external borders feebly concave, their apical borders straight, without denticles. Clypeus short, vertical, its anterior border rounded and entire. Frontal carinæ erect, rounded, not truncated posteriorly but gradually continued back into the short frontal furrow. Carina of cheeks short, prominent, but scarcely tooth-like, sending a branch backward to the anterior orbit and one inward to the antennal fovea. Occipital border of head sharply marginate, the margination surrounding the inferoposterior corners of the head and running forward on each side of the gula to a level with the posterior orbits. Postocular carina absent. Antennæ moderately long; scapes nearly $\frac{3}{5}$ as long as the head, incrassated at their tips; first funicular joint longer than broad; joints 2–9 a little broader than long, tenth joint as long as broad, terminal joint but slightly longer than the two preceding joints together. Thorax rather narrow, from above more than twice as long as broad, as broad through the pronotum as through the epinotum, feebly narrowed in the mesonotal region, sharply marginate in front, on the sides, between the base and declivity of the epinotum, along the lateral borders of the declivity and the prosterna. In profile the dorsal surface is rather flat, the epinotal declivity abrupt and slightly

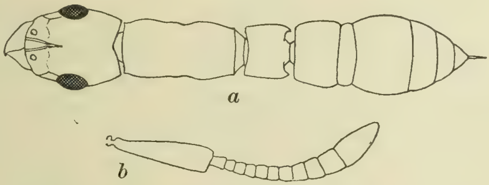

FIGURE 10. *Phyracaces scrutator* sp. nov. Worker, *a*, dorsal view of body, *b*, antenna of same.

concave, the posterior corners of the epinotum minutely and indistinctly dentate and the mesopleuræ are concave. Petiole slightly broader than the epinotum, rectangular, scarcely broader behind than in front and somewhat broader than long, its anterior border broadly concave, the lateral borders straight, the anterior corners rectangular, the posterior produced as acute, flattened teeth. The anterior and lateral borders are sharply marginate. In profile the dorsal surface is feebly convex, the anterior surface truncate and concave, the ventral surface in front with a swelling but without a tooth. Postpetiole somewhat broader than the petiole, a little broader than long and broader behind than in front, its sides feebly convex; these and the anterior border not marginate. First gastric segment broader than the petiole and broader than long. Pygidium very feebly concave above, marginate and minutely spinulose on the sides. Legs moderately long; hind coxæ with a large, rounded, translucent lamella at the tip on the inner side.

Subopaque, or lustrous; mandibles, clypeus and gaster more shining. Mandibles shagreened and very sparsely and coarsely punctate. Head, thorax, petiole and postpetiole very densely and finely reticulate, posterior portion of head and dorsal surface of thorax, petiole and postpetiole also with shallow, evenly but very sparsely distributed, piligerous foveolæ. Gaster, scapes and legs more superficially reticulate than the thorax, the gaster also with scattered, coarse, piligerous punctures.

Hairs yellow, rather coarse and long, subappressed, very sparse on the upper surface of the head, more abundant on the dorsum of the rest of the body, absent on the scapes and legs which have only a long, dilute, yellowish pubescence.

Rich red throughout, of the tint of *Polyergus rufescens,* with only the apical border of the mandibles, the edges of the frontal carinæ and the marginations of the thorax and petiole of a deeper tint.

Described from several specimens taken Nov. 10, 1914 at Toowong, near Brisbane, Queensland. They were running about rapidly under a stone, evidently in search of the brood of other ants.

This species is easily distinguished from all the other red species of *Phyracaces* by the subopaque, finely reticulate surface of the head, thorax, petiole and postpetiole.

24. **Phyracaces rugulinodis** sp. nov.

(Fig. 11.)

Male. Length 5 mm.

Head, including the eyes, broader than long, broadly convex and rounded behind, cheeks very short, eyes and ocelli very large and convex. Mandibles large, triangular, deflected, with concave external and very finely and indistinctly denticulate apical borders. Occipital border strongly marginate, continued below into two gular marginations which run forward to a level with the anterior orbits. Clypeus very short, with straight anterior border; frontal area represented by a deep pit; frontal carinæ subparallel, straight, half as long as the head. Antennæ 13-jointed, scapes reaching to the posterior orbit, cylindrical, not thickened at their tips; funiculus of uniform diameter throughout, all the joints longer than broad, cylindrical. Thorax narrower than the head through the eyes, pronotum swollen in the middle and on the sides; mesonotum rather regularly hexagonal, feebly convex, without Mayrian furrows. Epinotum with distinct base and declivity, the former feebly convex and sloping, the latter nearly vertical and concave, strongly marginate above and

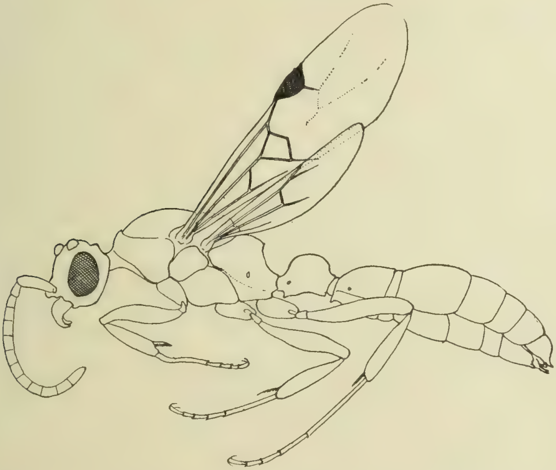

FIGURE 11. *Phyracaces rugulinodis* sp. nov. Male, lateral view.

on the sides. Petiole from above subrectangular, a little longer than broad, as broad in front as behind, with straight anterior and posterior borders and evenly rounded sides; in profile the dorsal surface is strongly convex, the anterior and posterior surfaces short and slightly concave, the former strongly marginate above and on the sides, the ventral surface with a small, sharp tooth at the anterior end. Postpetiole decidedly broader than the petiole, as long as broad, broader behind than in front, with convex sides and dorsum, with a small acute tooth at its anterior border on the ventral side. Gaster rather slender. Pygidium evenly and broadly rounded at the tip. Cerci absent. Genital appendages blunt, retracted. Hypopygium with broad posterior border, feebly and narrowly emarginate in the middle. Legs slender, hind coxæ without lamellate tips. Wings short, with large, thick pterostigma. There is a well-developed discal cell but the veins distal to it are so nearly obsolete that those outlining a closed marginal and single cubital cell are scarcely visible as very delicate folds in the wing membrane.

Mandibles and space between the frontal carinæ shining; mandibles coarsely and sparsely punctate; remainder of head opaque, finely and densely punctate, with very uneven surface. Sides of pronotum, the mesonotum and mesopleuræ smooth and shining, the mesonotum with scattered, piligerous foveolæ; middle of pronotum, the whole epinotum, petiole and postpetiole subopaque, finely punctate and rugulose, the rugæ on the base and sides of the epinotum coarse, somewhat longitudinal on the base near the margination separating it from the declivity; the latter finely and densely punctate. Gaster shagreened, coarsely on the base of the first segment, finely elsewhere so that the surface is shining.

Hairs yellow, bristly, suberect, pointed, scattered, covering the body and legs rather uniformly, present only on the anterior surfaces of the scapes. Pubescence yellowish, distinct only on the scapes.

Red; ocellar region, middle portions of tibiæ and femora, middle of pronotum and anterodorsal portions of petiole and first gastric segment brown. Wings whitish hyaline, with yellow veins and very conspicuous dark brown pterostigma.

Described from a single specimen from Murat Bay, South Australia (Museum of South Australia). There is another defective specimen in the same collection from Ardrossan, South Australia (J. G. O. Tepper).

This may be the male of one of the smaller red species of *Phyracaces* described in the preceding pages.

25. **Phyracaces mullewanus** sp. nov.

Male. Length 5.4 mm.

Head, including the eyes, much broader than long, with broadly rounded posterior portion and short cheeks, truncated behind the ocelli, with strongly marginate occipital border, the margination extending forward on each side of the gula to the level of the middle of the eyes. Eyes and ocelli large and prominent. Mandibles triangular, acutely pointed, rather narrow, with oblique, finely and evenly denticulate apical and concave external borders. Clypeus short, with straight, entire anterior border. Frontal carinæ rather far apart, parallel in front, approximated behind, half as long as the distance between the anterior clypeal border and the posterior ocelli. Antennal scapes not reaching to the posterior orbits; all the funicular joints, except the last, a little broader than long, last joint twice as long as the preceding, pointed. Thorax robust, as broad through the wing-insertions as the head through the eyes. Pronotum not very convex; mesonotum convex above, hexagonal, narrower in front than behind. Epinotum with distinct base and declivity, the former in profile feebly convex, shorter than the vertical, concave declivity, the latter strongly marginate above and on the sides. Petiole as broad as long, cuboidal, its upper surface convex, the anterior marginate above and on the sides. Postpetiole broader than the petiole, broader than long, broader behind than in front, with convex dorsal and lateral surfaces. First gastric segment of a similar shape but broader. Pygidium and hypopygium with broadly rounded tips. Cerci absent. Genital appendages retracted. Legs slender and rather short; hind coxæ without lamellate tips. Wings short, venation much as in *rugulinodis,* but veins of the distal portion of the discal cell obsolete and the pterostigma smaller, though thick.

Shining; mandibles coarsely punctate, their bases, the epinotum and petiole subopaque, finely and densely punctate; base and sides of epinotum and upper surface of petiole also rugulose. Head and scutellum shagreened; surface of occipital region very uneven; mesonotum with large, coarse, deep, scattered, piligerous foveolæ; postpetiole and first gastric segment with smaller and more numerous foveolæ; gaster shagreened.

Hairs yellowish, sparse, erect, pointed, and coarse, moderately long, shorter on the legs. Pubescence absent, except on the antennal funiculi.

Rich red; mesonotum with three brown blotches. Wings whitish hyaline, veins pale yellow, pterostigma dark brown, very conspicuous.

Described from a single specimen taken by Miss F. May at Mullewa, West Australia (Museum of South Australia).

This species is readily distinguished from *rugulinodis* by its larger size, more robust stature, smaller eyes and ocelli, shorter funicular joints, shorter petiole, more shining postpetiole, etc. It may be the hitherto unknown male of *Ph. singularis* or of an allied species.

26. **Phyracaces ficosus** sp. nov.

(Fig. 12).

Worker. Length 5.5–6 mm.

Head slightly longer than broad, distinctly broader behind than in front, convex above and on the sides, with excised posterior border and rather acute inferoposterior corners. Eyes rather large, feebly convex, at the middle of the sides of the head; ocelli absent. Mandibles triangular, deflected, with finely denticulate apical border passing through a rounded angle into the basal border; external border rather straight. Clypeus very short, vertical. Frontal carinæ large, erect, rounded, not truncated at their confluence behind. Carina of cheeks short, with a prominent blunt tooth. Postocular carina absent. Occipital border of head strongly marginate, the margination continued forward on each side of the gula to the level of the middle of the eyes. Antennæ stout; scapes a little less than half as long as the head, gradually incrassated towards their tips; none of the funicular joints, except the ultimate and penultimate, longer than broad, the ultimate tapering and pointed, not longer

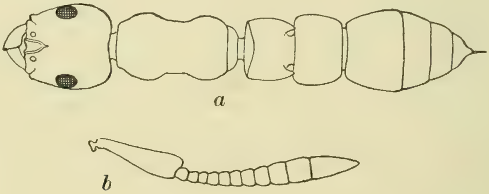

FIGURE 12. *Phyracaces ficosus* sp. nov. Worker, *a*, dorsal view of body, *b*, antenna of same.

than the two preceding together. Thorax as broad through the pronotum as through the epinotum, distinctly narrowed in the middle, the dorsum feebly convex, the mesopleuræ rather concave, the epinotal declivity nearly vertical, feebly concave. The anterior border of the pronotum, the sides of the dorsum, the boundary between the epinotal base and declivity, the sides of the latter and the prosterna sharply marginate. Petiole as broad as the epinotum, nearly $1\frac{3}{4}$ times as broad as long, as broad behind as in front, with feebly and evenly rounded sides, concave anterior border and the posterior corners projecting as flattened, rather acute teeth. Only the anterior and lateral borders are marginate. In profile the dorsal surface is feebly convex, the anterior surface vertical and joining it at a right angle, the ventral surface with a strong, pointed tooth at the anterior end. Postpetiole broader than long, broader than the petiole and distinctly broader in front than behind, with distinctly rounded anterior, lateral and posterior borders, the lateral borders marginate. First gastric segment a little broader than long and a little broader than the postpetiole, distinctly broader behind than in front. Pygidium with a large concave depression on its dorsal side, marginate and minutely spinulose on the sides. Legs moderately stout; coxæ of hind pair with a small, translucent lamella at the tip on the inner side.

Smooth and shining; mandibles coarsely and sparsely punctate. Dorsal surface of body with small, scattered, piligerous punctures.

Hairs grayish yellow, erect, rather long, slender, pointed and sparse, not appreciably longer and denser on the gaster than on the remainder of the body, shorter and somewhat more oblique on the scapes and legs. Legs, coxæ and scapes with rather long, appressed, grayish pubescence.

Black; gaster, except the extreme base of the first segment rich, cherry red. Mandibles, except their bases and borders, insertions and terminal joints of antennæ, tarsi and articulations of legs and the space between the frontal carinæ, reddish brown.

Described from a dozen specimens taken Dec. 4, 1914 in the Bulli Pass, New South Wales. They were running over the sand in a loose file, carrying the nude pupæ of a Myrmicine ant whose nest they had just plundered.

This beautiful species is easily distinguished by its peculiar color and the shape of its petiole.

27. **Phyracaces elegans** sp. nov.

(Fig. 13.)

Worker. Length 3–3.5 mm.

Head longer than broad, broader behind than in front, convex above, with truncated occipital region and gula, blunt posterior corners and excised posterior border. Eyes rather large, flat, distinctly in front of the middle of the sides; ocelli absent. Carina of cheeks forming a blunt, rectangular tooth. Postocular carina absent. Posterior border of head marginate, the margination surrounding the infero-posterior corners and extending forward on each side of the gula about $\frac{1}{3}$ the length of the head. Mandibles triangular, deflected, with finely denticulate apical and rather convex external borders. Frontal carinæ moderately large, erect, rounded, confluent but not truncated behind. Antennæ rather robust; scapes half as long as the head, gradually thickened towards their tips; funicular joints 1–9 distinctly broader than long, tenth joint longer than broad, terminal joint tapering and pointed, a little longer than the two preceding joints together. Thorax narrower than the head, as broad through the pronotum as through the epinotum, narrowed in the mesonotal region; in profile rather flat above, with straight, abrupt epinotal declivity. All four sides of the dorsum, the prosterna and sides of the epinotal declivity are distinctly marginate, and the epinotum bears a pair of small acute teeth. Petiole rectangular, somewhat broader than long, as broad as the epinotum, its anterior border slightly concave, the lateral borders marginate, with small acute, dentiform posterior corners. In profile the petiole is flat above and concave on the sides, the anterior surface is abrupt and forms somewhat less than a right angle with the dorsal surface, the

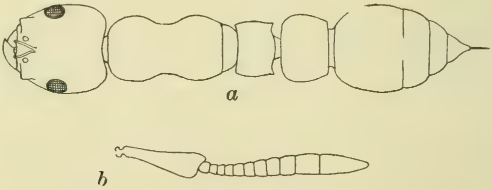

FIGURE 13. *Phyracaces elegans* sp. nov. Worker, *a*, dorsal view of body, *b*, antenna of same.

ventral surface with a blunt, compressed tooth in front. Postpetiole a little broader than the petiole, subrectangular, scarcely broader behind than in front, convex above and on the sides, the latter sharply marginate. First gastric segment broader than long and broader than the postpetiole, a little broader behind than in front. Pygidium feebly concave above, marginate and minutely spinulose on the sides. Legs moderately stout; coxæ of the hind pair with a large, rounded, translucent lamella at the tip on the inner side.

Smooth and shining; mandibles coarsely and sparsely punctate. Upper surface of body with very sparse piligerous punctures, which are large on the vertex of the head and the middle of the postpetiole.

Hairs yellowish, sparse, rather long, slender, erect, shorter and more oblique on the appendages. Sides of petiole, coxæ, legs and antennal scapes with conspicuous grayish pubescence.

Reddish yellow; postpetiole and gaster, except the tip, black or very dark brown; pronotum and often also the sides of the mesonotum and sides and posterior portions of the base of the epinotum castaneous or reddish brown; mandibles, antennæ, legs and tip of gaster reddish brown, varying in depth of hue in different specimens.

Female. Length 4.5 mm.

Resembling the worker, but with larger eyes, ocelli and a different thorax. The latter is narrower than the head and like the thorax of the worker in shape, but with distinct pronotal, mesonotal, scutellar, metanotal, parapteral, sternal and mesepimeral sclerites, though there are no traces of wing stumps. The mesonotum is very small and flat, suborbicular, scarcely longer than broad. The gaster is much larger than in the worker, fully twice as long as broad.

Sculpture, pilosity and color much as in the worker, ocellar region with a brown cloud.

Described from forty workers and a single female, forming the greater portion of a single colony taken Sept. 16, 1914 near Southerland, a short distance from Sydney, New South Wales. The ants were bunched together under a large piece of sandstone in a thin layer of earth which in turn was lying on the sandstone wall of a deep ravine. There were no larvæ, and as the preceding night had been very rainy, I infer that the colony had been washed out of its nest and had taken refuge in the place in which it was found. Two workers taken by Mr. E. H. Zeck at Berowra, N. S. W., and belonging to Dr. W. M. Mann, are also referable to this species, which differs from all the preceding members of the genus in its peculiar color and small size.

28. **Phyracaces turneri** Forel.

(Fig. 14.)

Cerapachys (*Phyracaces*) *turneri* Forel, Rev. Suisse Zool. 10, 1902, p. 405, ☿ ♀; Ark. f. Zool. 9, 1915, p. 18, ☿.

Cerapachys turneri Froggatt, Agric. Gaz. N. S. W., 1905, p. 15.

Phyracaces turneri Emery, Gen. Insect. Fasc. 118, 1911, p. 11.

Worker. Length 3.5–4 mm.

Head longer than broad, a little narrower in front than behind, truncated and slightly constricted in the occipital region, convex above, with acute inferoposterior corners, rather deeply excised occipital border and moderately large, convex eyes, placed near the middle of the sides. Ocelli absent. Carina of the cheeks with a prominent tooth or angle. Postocular carina absent; occipital border of head strongly marginate, the margination surrounding the posterior angles and running forward on each side of the gula to a level with the posterior orbits. Clypeus short and vertical. Frontal carinæ erect, rounded, abruptly truncated behind where they are very close together. Antennæ rather robust; scapes longer than half the head, rapidly enlarging towards their tips; funicular joints 1–9 as long as broad, tenth joint longer than broad, terminal joint tapering, pointed, a little longer than the two preceding joints together. Thorax rectangular, scarcely more than $1\frac{1}{2}$ times as long as broad, robust, scarcely narrowed in the middle, evenly convex above in profile, with straight, vertical epinotal declivity; anterior and lateral borders, boundary between the epinotal base and declivity and sides of the latter sharply marginate, anterior pronotal angles and corners of epinotum acutely dentate. Petiole a little broader than the epinotum, rectangular, broader than long, a little broader behind than in front,

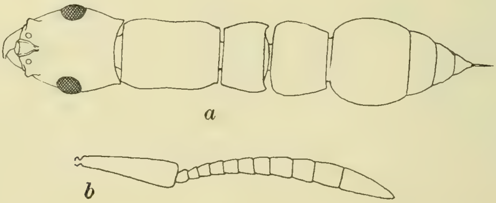

FIGURE 14. *Phyracaces turneri* Forel. Worker, *a*, dorsal view of body, *b*, antenna of same.

its posterior angles produced as small, flattened teeth, its sides, anterior and posterior borders marginate. In profile it is feebly convex above, concave on the sides, with abrupt, vertical anterior surface, joining the dorsal surface at a right angle, and the ventral surface with a blunt tooth at the anterior end. Postpetiole rectangular, a little broader than long, and a little broader than the petiole, slightly broader in front than behind, with straight sides, anterior and posterior borders and rounded, flattened anterior angles. The anterior and lateral borders are strongly marginate. First gastric segment a little broader than the postpetiole, with convex dorsum and sides. Pygidium bluntly pointed at the tip, concave above, marginate and minutely spinulose on the sides. Legs rather long; hind coxæ with a large, rounded, translucent lamella at the tip on the inner side.

Smooth and shining; mandibles coarsely punctate; head and body above with sparse, piligerous punctures, which are large and conspicuous on the vertex. Sides of pygidium and posterior borders of gastric segments densely and finely punctate. Scapes and legs with numerous, minute, piligerous punctures.

Hairs grayish yellow, erect, pointed, sparse, long and rather uniformly distributed on the body, shorter and more oblique on the appendages. Legs and scapes with distinct grayish pubescence.

Black; mandibles, pygidium, sting, antennæ and legs brownish red.

Female (deälated). Length 4.1 mm.

Like the worker except for the ocelli and thoracic sclerites. Mesonotum and scutellum very small and flat. Stumps of wings distinct.

Queensland: Mackay, type locality (Gilbert Turner); Cedar Creek (E. Mjöberg); Kuranda (Wheeler).

I have redescribed the worker from nine specimens which I found running over dead leaves in the dark tropical "scrub" near Kuranda. The description of the female is taken from Forel. The worker of this species is readily distinguished from that of the other black species of *Phyracaces* by the longer funicular joints and the shape of the petiole and postpetiole and from all but *Ph. senescens* by its short, thickset thorax.

29. **Phyracaces larvatus** sp. nov.

(Fig. 15.)

Worker. Length 3–3.6 mm.

Head longer than broad, a little narrower in front than behind, with feebly convex sides, concave posterior border and short, rather blunt inferoposterior corners. Eyes large and moderately convex, nearly as long as their distance from the anterior border, a little in front of the middle of the head. Carina of cheeks very prominent, forming a strong, rectangular tooth. Postocular carina absent. Occipital border of head marginate, the margination surrounding the inferoposterior corners and running forward on each side of the gula to the level of the posterior orbits. Mandibles triangular, deflected, with concave external and finely denticulate apical borders. Frontal carinæ rather far apart, suberect, feebly emarginate but not truncate behind before they meet. Antennæ rather stout; scapes a little longer than half the head, gradually incrassated towards the tip; funicular joints 1–9 distinctly broader than long, tenth joint not longer than broad, terminal joint pointed, nearly as long as the three preceding joints together. Thorax subrectangular, nearly twice as long as broad, as broad through the pronotum as through the epinotum, very feebly narrowed in the middle, in profile evenly convex above, epinotal declivity flat, very abrupt. There are marginations on the anterior and lateral borders, between the epinotal base and declivity, along the sides of the latter and extending down the prosterna. Above the epinotum bears a pair of minute teeth. Petiole slightly narrower than the epinotum, broader than long, as broad behind as in front, with rounded sides, rather sharp, flattened, posterior teeth and concave anterior border. The anterior and lateral borders are marginate. In profile the dorsal surface is feebly convex, the anterior surface vertical and truncated, and there is a small, translucent, backwardly directed tooth on the anteroventral surface. Postpetiole decidedly broader than the petiole, a little broader than long, broader in front than behind, separated by a strong constriction from the gaster; its anterior corners are rounded and flattened, its sides straight, its anterior and posterior borders are concave, its anterior and lateral borders sharply marginate. First gastric segment broader than the

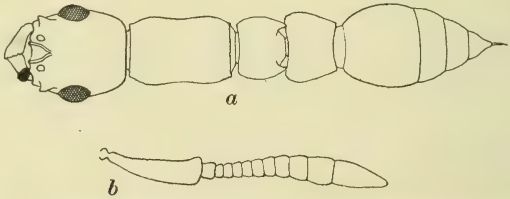

Figure 15. *Phyracaces larvatus* sp. nov. Worker, *a*, dorsal view of body, *b*, antenna of same.

postpetiole, a little broader than long and a little broader behind than in front. Pygidium concave above, with marginate, minutely spinulose sides. Legs moderately long; hind coxæ with a large, angular, translucent lamella at the tip on the inner side.

Smooth and shining; mandibles coarsely punctate; head and thorax above with numerous piligerous foveolæ, gaster with piligerous punctures.

Hairs covering the body and appendages sparse, white, rather long, suberect and delicate. Pubescence pale, dilute, distinct only on the appendages.

Black; mandibles, cheeks, front, clypeus, legs, sting, pygidium and incisures of abdomen, dark red.

Described from numerous specimens from a single colony taken Sept. 19, 1914 from under a small stone in the bottom of one of the deep gorges at Katoomba in the Blue Mts. of New South Wales.

This species seems to be very close to *Ph. adamus* Forel, but differs in its smaller size, less rectangular petiole, somewhat smaller eyes, broader eighth and ninth funicular joints and the red front of the head.

30. **Phyracaces adamus** Forel.

Cerapachys (*Phyracaces*) *adamus* Forel, Rev. Suisse Zool. 18, 1910, p. 18, ☿.

Phyracaces adamus Emery, Gen. Insect. Fasc. 118, 1911, p. 11, ☿.

Queensland: Kuranda (Rowland Turner).

The worker of this species, which I have not seen, is, according to Forel, close to *turneri*, but larger (4.2–4.8 mm.), with the eyes much more developed and the head of a different conformation.

31. **Phyracaces senescens** sp. nov.

(Fig. 16.)

Worker. Length 3.6–4 mm.

Head longer than broad, as broad in front as behind, with moderately large, flattened eyes, placed at the middle of its sides. Ocelli absent. Upper surface of head convex, occipital surface truncated, sides scarcely convex, occipital border broadly excised, marginate, the margination surrounding the rather acute inferoposterior corners and running forward on each side of the gular surface to the middle of the head. Postocular carina absent. Carina of cheeks well developed, produced as a prominent angle. Mandibles triangular, deflected, with nearly straight external and finely denticulate apical borders. Clypeus short, vertical. Frontal carinæ erect, not very prominent, rather small, not truncated before their confluence behind. Antennal scapes not more than half as long as the head, gradually incrassated toward their tips, funicular joints 1 and 10 slightly longer than broad, joints 2–9 distinctly broader than long, terminal joint rather swollen and scarcely tapering, a little longer than the two preceding joints together. Thorax a little more than twice as long as broad, as broad through the pronotum as through the epinotum, slightly narrowed in the mesonotal region and with concave mesopleuræ. Marginations developed on the anterior and lateral borders, on the boundary between the epinotal base and declivity, along the sides of the latter and the prosterna. Upper corners of epinotum not dentate. In profile the thoracic dorsum is very feebly and evenly convex, the declivity of the epinotum steep and straight. Petiole as broad as the epinotum, rectangular, broader than long, broader behind than in front, with concave anterior, straight lateral and nearly straight posterior border and its posterior angles produced as acute, slightly incurved teeth. The lateral borders are marginate, the anterior border submarginate. In profile the dorsal surface is flat and forms a right angle with the truncated, vertical anterior surface, the posterior surface is concave and slightly sloping, the ventral surface bears a pointed, triangular tooth at its anterior end. Postpetiole broader than the petiole, nearly as long as broad, not very sharply separated from the gaster, with rounded dorsal and lateral surfaces and anterior angles. First gastric segment broader than long and decidedly broader than the postpetiole. Pygidium with a shallow elliptical impression on its dorsal surface, its sides beset with

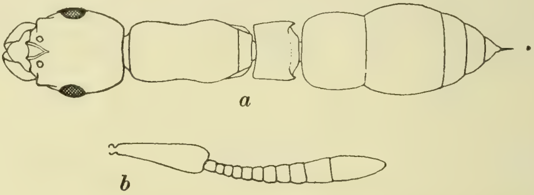

Figure 16. *Phyracaces senescens* sp. nov. Worker, *a*, dorsal view of body, *b*, antenna of same.

a row of minute spinules. Legs rather stout; tip of hind coxæ on the inner side produced as a rounded, translucent lamella.

Mandibles shining, coarsely punctate; head and thorax smooth and shining, above with coarse, sparse, piligerous punctures; petiole, postpetiole and gaster, except the intersegmental regions, more opaque, finely and densely punctate.

Hairs white, rather long and delicate, suberect and pointed; on the petiole, postpetiole and gaster in part appressed and more abundant, but not concealing the sculpture. Pubescence abundant and rather long, whitish, confined to the coxæ, legs and venter.

Black; mandibles, pygidium, sting, funiculi, tips of scapes, tarsi, coxæ and bases and tips of femora and tibiæ castaneous.

Described from numerous workers taken at Salisbury Court, near Uralla, New South Wales, from a single colony which was running about on a foraging expedition.

This species is easily distinguished from the other black species of *Phyracaces* by its subopaque abdomen and its long, appressed, pale hairs, which give it a grayish appearance.

32. **Phyracaces binodis** Forel.

(Fig. 17.)

Cerapachys (*Phyracaces*) *binodis* Forel, Rev. Suisse Zool. 18, 1910, p. 20, ☿.

Phyracaces binodis Emery, Gen. Insect. Fasc. 118, 1911, p. 11.

Worker. Length 3.8–4 mm.

Head longer than broad, nearly as broad in front as behind, moderately convex above and truncated in the occipital region. Eyes rather large and flat, situated a little in front of the middle of the sides. Ocelli absent. Carina of cheeks forming a prominent angle. Postocular carina absent. Occipital border of head broadly excised, strongly marginate, the margination surrounding the acute inferoposterior corners and running forward on each side of the gular surface about $\frac{1}{3}$ the length of the head. Mandibles triangular, convex, deflected, their apical borders minutely denticulate, their external borders slightly concave. Clypeus short and vertical. Frontal carinæ erect, rounded, truncated behind where they meet. Antennæ rather long; scapes about $\frac{3}{5}$ as long as the head, all the funicular joints, except the last, distinctly broader than long, last joint rather large and swollen, longer than the two preceding joints together. Thorax subrectangular, about twice as long as broad, as broad through the pronotum as through the epinotum, distinctly narrowed in the middle, with concave mesopleuræ; anterior border straight and transverse, submarginate; prosterna, lateral borders and boundary between the epinotal base and declivity marginate, sides of the latter scarcely submarginate. Epinotum above with a pair of distinct teeth. Petiole nearly as long as broad, rectangular, marginate only on the sides, its anterior corners sharp, its posterior corners forming short, acute, flattened teeth, its anterior border feebly concave. In profile the dorsal surface is rather flat, the anterior surface very abrupt, forming less than a right angle with the dorsal surface, the posterior surface sloping, the ventral surface with an acute, translucent, backwardly directed tooth. Postpetiole of much the same shape as the petiole but somewhat longer, though not broader and with the anterior corners less acute; it is very strongly constricted off from the first gastric segment and has the anterior and lateral borders marginate. First gastric segment broader than the postpetiole, longer than broad, broader behind than in front. Pygidium feebly impressed on the dorsal side, bordered with minute spinules. Legs rather slender, coxæ of hind pairs with an erect, translucent lamella at the tip on the inner side.

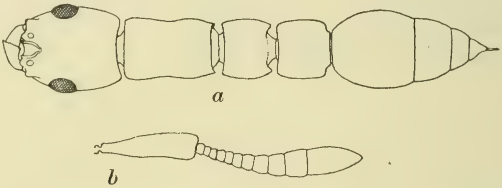

FIGURE 17. *Phyracaces binodis* Forel. Worker, *a*, dorsal view of body, *b*, antenna of same.

Smooth and shining; mandibles coarsely punctate; upper surface of body with rather evenly distributed, coarse, piligerous punctures.

Hairs delicate, whitish, rather long, pointed, erect, covering the body and appendages, somewhat shorter and more oblique on the latter. Pubescence very feebly developed, distinct only on the coxæ and antennal scapes.

Black; mandibles, antennæ, front, cheeks, legs including coxæ, pygidium and incisures of the abdomen on the ventral side reddish brown.

Queensland: Kuranda (Rowland Turner).

Redescribed from a cotype received from Prof. Forel and numerous specimens taken Oct. 3, 1914 at Kuranda from a single colony, which was nesting in a small cavity in a red-rotten log in the dark "scrub."

This form is readily distinguished by the shape of the petiole and postpetiole and the pronounced constriction between the latter and first gastric segment.

Genus **Cerapachys** *F. Smith.*

33. **Cerapachys (Syscia) australis** Forel.

Syscia australis Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 68, ☿; Froggatt, Agric. Gaz. N. S. W., 1905, p. 14.

Cerapachys (*Syscia*) *australis* Emery, Gen. Insect. Fasc. 118, 1911, p. 10, ☿; Crawley, Ann. Mag. Nat. Hist. (8) 15, 1915, p. 133, ☿.

Worker. Length 3–3.5 mm.

Head about $\frac{1}{5}$ longer than broad, subrectangular, as broad in front as behind, with evenly convex sides, broadly excised posterior border and short, rather pointed posterior corners. Eyes absent. Mandibles subtriangular, deflected, with distinctly dentate apical and basal borders. Clypeus extremely short. Frontal carinæ approximated, erect, surrounding the antennal insertions in front, converging and truncated behind where they fuse in a depression uniting the antennal foveæ. Carinæ of cheeks indistinct. Antennal scapes robust, slender at their insertions, less than half as long as the head; first funicular joint as long as broad, joints 2–7 broader than long, terminal joint large, glandiform, as long as the four preceding joints together. Thorax decidedly narrower than the head, a little more than twice as long as broad, as broad behind as in front, slightly narrowed in the mesonotal region, without transverse sutures; humeri and corners of epinotum rounded; in profile the dorsal surface is straight, the epinotal declivity abrupt, marginate on the sides and submarginate above; the pronotum submarginate in front. Petiole narrower than the epinotum, rounded cuboidal, scarcely broader than long and scarcely broader behind than in front, with convex sides and a blunt, compressed tooth on its anteroventral surface. Postpetiole resembling the petiole but broader, distinctly broader than long and a little broader behind than in front, with rounded anterior corners, feebly convex sides and a very protuberant anteroventral surface. First gastric segment very large, about $\frac{1}{3}$ longer than broad, much longer than the remaining segments together, distinctly flattened dorso-ventrally and with feebly convex sides. Pygidium small, truncated, entire, its border spinulose. Legs rather long.

Shining; mandibles coarsely punctate; head, thorax, petiole and postpetiole covered with large, sparse, piligerous punctures; gaster somewhat more finely and densely punctate.

Erect hairs yellow, rather abundant, moderately long, and of uneven length, covering the body and appendages, longest on the tip of the gaster. Pubescence dilute, conspicuous only on the gaster, legs and scapes.

Yellowish red; legs, scapes and terminal antennal joint paler; mandibles, frontal carinæ and anterior border of cheeks brownish.

Queensland: Mackay, type-locality (Turner); Bribie Island, near Brisbane (H. Hacker).

Northern Territory: Darwin (G. F. Hill).

Redescribed from a couple of cotypes received from Prof. Forel. Mr. Henry Tryon informs me that this ant is not uncommon in some parts of Queensland but is easily overlooked because it leads a hypogæic life.

34. **Cerapachys (Syscia) australis** var. **edentata** Forel.

Syscia australis var. *edentata* Forel, Ann. Soc. Ent. Belg. 44, 1900, p. 69, ☿.

Syscia australis var. *endentata* (sic!) Froggatt, Agric. Gaz. N. S. W., 1905, p. 14, ☿.

Cerapachys (*Syscia*) *australis* var. *edentula* (sic!) Emery, Gen. Insect. Fasc. 118, 1911, p. 10, ☿.

Queensland: Mackay, type-locality (Turner); Brisbane (H. Tryon).

This form differs from the typical *australis* in its deeper, more reddish coloration, somewhat feebler and sparser puncturation, somewhat more transverse first to seventh funicular joints and especially in lacking teeth on the apical and basal borders of the mandibles.

Genus **Lioponera** *Mayr.*

35. **Lioponera australis** Forel.

Lioponera longitarsis Mayr var. *australis* Forel, Ann. Soc. Ent. Belg. 39, 1895, p. 422, ☿; Froggatt, Agric. Gaz. N. S. W., 1905, p. 8; Emery, Gen. Insect. Fasc. 118, 1911, p. 12.

Queensland: Mackay (Turner).

Owing to the profound differences between the Australian ant fauna and that of India it is improbable that this from is merely a variety of *L. longitarsis* Mayr of the latter country. Forel, in his brief description calls attention to the following peculiarities of *australis,* but the study of more material will in all probability reveal others: Length 3.4 mm. It is smaller than *longitarsis* and has somewhat smaller and more convex eyes. The petiole is transversely rectangular, whereas in *longitarsis* its anterior corners are more projecting and its anterior border is distinctly concave. The sculpture of *australis* is more regularly punctate and the postpetiole is blackish brown, with two large, reddish spots.

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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LXI. No. 13.

JAMAICAN ANTS COLLECTED BY PROF. C. T. BRUES.

By William Morton Wheeler.

With Two Plates.

CAMBRIDGE, MASS., U. S. A.
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December, 1917.

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No. 13.— *Jamaican Ants collected by Prof. C. T. Brues.*

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CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE
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A fine series of ants recently collected in Jamaica by Professor Brues is of unusual interest because most of them were taken in new localities and comprise several forms new to science or unrecorded in my papers on Jamaican ants published in 1908, 1911, and 1913. There are also a few new records in Forel's paper of 1912 on the neotropical ants. I have included these, prefixing all the new records with an asterisk. With the additions and a few changes in nomenclature necessitated by the study of more abundant material, some 70 species, subspecies, and varieties of Formicidae are now known from Jamaica.

1. *Platythyrea punctata* (F. Smith) var. *pruinosa* Mayr. ☿ —Montego Bay (Amer. Mus. Coll.).

Forel has shown that the form of this species occurring in Jamaica is the var. *pruinosa* and not the typical form.

2. *Ectatomma* (*Holcoponera*) *striatulum* Mayr. ☿.— Newton, 3,000 ft.; Kingston.

The series from the former locality comprises 28 workers, from the latter a single specimen which is smaller, more reddish, with less pronounced mesoëpinotal angle in profile and longer spines on the hind coxae. It may represent a distinct subspecies, but the material is insufficient to justify the introduction of a new name.

3. *Euponera* (*Trachymesopus*) *stigma* (Fabricius). ☿.— Cinchona, 5,000 ft.
4. *Ponera opaciceps* Mayr. ☿ ♂.— Newton, 3,000 ft.
5. *Ponera trigona* Mayr. var. *opacior* Forel. ♀.— Newton, 3,000 ft.

*6. *Leptogenys puncticeps* Emery. ☿.— Newton, 3,000 ft.

Not hitherto recorded from Jamaica, though known from Grenada and resembling the form from that island in all respects. The types are from Costa Rica. Forel has described a subspecies *vincentensis* from the island of St. Vincent. It has the legs entirely red and the anterior clypeal projection and posteromedian projection of the petiole are less pointed than in the typical form.

7. *Odontomachus haematoda* (Linné) subsp. *insularis* Guérin. ☿.— Liguanea Plain.
8. *Odontomachus haematoda* subsp. *insularis* var. *ruginodis* Wheeler. ☿ ♀.— Newton, 3,000 ft.
9. *Pseudomyrma flavidula* F. Smith var. *delicatula* Forel. ☿.— Kingston.

*10. *Pseudomyrma eduardi* Forel. ☿.— Newton, 3,000 ft.

A single specimen agreeing perfectly with Forel's description.

11. *Monomorium carbonarium* F. Smith subsp. *ebeninum* Forel. ☿ ♀.— Kingston.
12. *Cardiocondyla emeryi* Forel. ♂.— Liguanea Plain.

A single specimen with the head darker and the epinotal spines somewhat longer than in specimens from other localities in my collection.

13. *Solenopsis geminata* (Fabr.). ☿ ♀ ♂.— Newton, 3,000 ft.; Liguanea Plain.
14. *Pheidole fallax* Mayr. ♃ ♀.— Newton, 3,000 ft.

*15. *Pheidole fallax* Mayr var. *ovalis* Forel.

According to Forel the soldier of this variety, which he recently described from Jamaica, differs from the typical *fallax* in having the head rather oval, with much more convex sides and much narrower behind. The occipital lobes are narrower, more prominent and more densely rugose. I refer specimens from Kingston (M. Grabham) to this variety, but other specimens from Balaclava (A. E. Wight) seem to be intermediate between it and the typical form.

16. *Pheidole rodoszkowskii* Mayr var. *opacissima* Forel. ♃ ☿.— Newton, 3,000 ft.
17. *Pheidole megacephala* (Fabr.). ♃.— Cinchona, 5,000 ft.
18. *Pheidole caribbaea* Wheeler. ♀.— Newton, 3,000 ft.

A single deälated specimen agreeing with the gynetypes taken by Wight at Balaclava, except that the body is somewhat more hairy like that of the following subspecies:

*19. *Pheidole caribbaea* subsp. *sloanei*, subsp. nov.

Soldier. Differing from the typical form in the following particulars:— the head is a little smaller, the sculpture of the head and especially of the thorax, pedicel, and gaster is distinctly feebler and more superficial, the occipital corners of the head being smooth and shining and the pronotum somewhat shining, though transversely rugose above. The rugae on the head lateral to the front are not longitudinal but reticulate, or at any rate indistinctly longitudinal, whereas they are sharply longitudinal in the typical form. The hairs on the body and appendages are longer and more abundant. The color is paler, the body and legs being dark brown throughout or with only the scapes and metanotum darker or blackish. The tarsi are yellowish as in the type.

Worker. Like the worker of the typical form but of a slightly paler brown color and with the hairs on the legs and scapes longer and less oblique and those on the head and thorax more numerous.

Female. Differing from the female of the typical *caribbaea* in nearly the same characters as the soldier. The occipital border of the head is shining, but the anteromedian shining streak on the mesonotum is somewhat less pronounced. Wings long, colorless, with dark brown pterostigma and very pale brown veins.

Described from eight soldiers, one worker, and three females taken at Newton, 3,000 ft.

*20. *Pheidole punctatissima* Roger subsp. *jamaicensis* Wheeler var. *barbouri* Wheeler. ♃ ☿.— Cinchona, 5,000 ft.

Almost indistinguishable from the types. Possibly imported with plants into Jamaica from Cuba.

21. *Pheidole flavens* Roger. ♃ ☿.— Kingston.

*22. *Pheidole floridana* Emery subsp. *stomachosa*, subsp. nov.

Soldier. Differing from the typical *floridana* in having distinctly longer antennae and the longitudinal rugae on the clypeus and anterior portion of the head more pronounced. They are also present lateral to the frontal carinae on the feeble scrobe-like depressions which are merely finely and densely punctate in *floridana.* The humeral angles and lateral conules of the postpetiole are more acute. The sculpture of the thorax is more pronounced but that of the petiole and postpetiole is feebler so that these segments are more shining. The gaster is opaque and finely punctate at the extreme base above. The head, thorax, pedicel, and gaster are chestnut-brown, the legs and antennae yellow. The pilosity is precisely like that of *floridana.*

Worker. Head and pronotum very smooth and shining, unlike the same parts in *floridana,* which are opaque and densely and finely punctate. The antennae are longer, the scapes extending beyond the occipital border of the head. The sparse, erect hairs on the body are blunt but not thickened as in *floridana.* The color is the same as that of the soldier.

Female (deälated). The head has the posterior corners shining but is otherwise opaque and with the longitudinal rugae sharp and extending to the posterior corners. Color like that of the soldier.

Described from numerous specimens of all three phases from Newton, 3,000 ft.

*23. *Pheidole* (*Ceratopheidole*) *hecate* Wheeler subsp. *bruesi,* subsp. nov.

Soldier. Differing from the subsp. *malevola* Wheeler as follows:— the head is somewhat smaller. The rugae on the front of the head are less pronounced, and the sides, lateral to the frontal carinae, are very smooth and shining, with only a few short rugae at the anterior border of the cheeks and a few indistinct rugae median to the eyes. The antennal scapes are longer, reaching the posterior corners of the head. The thorax is more shining, with the transverse rugae sharper and more regular and without the punctate interrugal spaces of *malevola.* The long epinotal spines are distinctly more curved and less erect. The color of the body and appendages is darker, being nearly black, the mandibles darker red, with black borders.

Worker. Differing from the worker *malevola* only in its darker color and in the epinotal spines, which like those of the soldier are more curved and less erect.

Described from six soldiers and 26 workers from Newton, 3,000 ft.

24. *Crematogaster steinheili* Forel. ☿.— Kingston.

Forel now regards this form as a distinct species and not as a variety of *victima* F. Smith.

25. *Crematogaster brevispinosa* Mayr subsp. *vicina* Ern. André. ☿ ♀ ♂.— Newton, 3,000 ft. (Brues); Kingston (E. A. Andrews, M. Grabham); Balaclava, Troy (A. E. Wight).

Forel regards this as a subspecies of *brevispinosa,* distinguished from the typical form by the absence of the tooth on the lower anterior surface of the petiole. The tooth is present, however, in the workers of some colonies, though very small. His statement that the antennal scapes reach the occipital border of the head does not agree with my observations. The material collected from the localities mentioned above shows that my var. *wighti* is untenable. André undoubtedly drew his color description of *vicina* from immature specimens, as I find two colonies in which part of the workers have the pale color he describes while others have the dark mature color on which I based the var. *wighti*. Different colonies also show considerable differences in the size of the workers, from 1.8 mm. to 3.5 mm.

The female measures 4.5–5.5 mm. and is very smooth and shining throughout, of a rich castaneous color, with the antennae and legs a little paler and the gaster nearly black. The antennal scapes do not reach to half the distance between the posterior orbits and the posterior corners of the head. The epinotal spines are reduced to minute, acute teeth and the petiole bears a vestige of a tooth at its anterior ventral border.

The male measures about 2 mm. and is sordid yellow, with the head and apex of the gaster dark brown, the clypeus and some clouds on the thorax pale brown. The wings are long and whitish hyaline, with colorless veins and pterostigma.

This ant constructs an interesting, more or less globular or turnip-shaped, black carton nest about four to six inches in diameter on trees and fences. The accompanying plates (Plates **1**, **2**) from photographs by Professor Brues give excellent views of its external and internal structure.

*26. *Cryptocerus* (*Cyathocephalus*) *varians* F. Smith.

Forel states that he took this species in the botanical garden at Kingston.

27. *Cyphomyrmex rimosus* (Spinola) subsp. *minutus* Mayr. ♂.— Liguanea Plain.

28. *Cyphomyrmex foxi* Ern. André. ☿ ♀.— Newton, 3,000 ft.

Numerous specimens from four colonies. The female, hitherto undescribed, is represented by a single, deälated individual. It measures 3.4 mm. and closely resembles the worker in color, sculpture, and pilosity and in the structure of the head. The spines on the humeri of the pronotum are long and stout. The mesonotum is flattened above, as broad as long, with a pair of low longitudinal welts anteriorly and expanded postero-lateral borders, bluntly dentate anteriorly and posteriorly. The scutellum is bluntly bidentate and projecting. The epinotum is abruptly declivous, without distinct base and declivity, and with a pair of longitudinal ridges terminating behind in large, blunt, compressed teeth. Between these ridges the surface is transversely rugose. The petiole is small and similar to that of the worker, the postpetiole very large, broader than long, subrectangular when seen from above, with two short, blunt, longitudinal ridges, terminating in large blunt projections behind and separated by a deep concavity. The gaster is broadly oval, hardly longer than broad, rounded above, on the sides and behind, without longitudinal ridges and with a distinct median longitudinal groove at the base.

29. *Iridomyrmex iniquus* Mayr. ☿.— Cinchona, 5,000 ft.
30. *Iridomyrmex iniquus* Mayr var. *nigellus* Forel. ☿.— Kingston.
31. *Prenolepis* (*Nylanderia*) *longicornis* Latr. ☿ ♀.—Newton, 3,000 ft.
32. *Prenolepis* (*Nylanderia*) *vividula* Nyl. ☿.— Cinchona. 5,000 ft.
33. *Brachymyrmex heeri* Forel var. *obscurior* Forel. ☿ ♀ ♂.— Cinchona, 5,000 ft.
34. *Camponotus* (*Myrmoturba*) *conspicuus* F. Smith.

Worker maxima. (Fig. 1, a). Length 8–10 mm.

Head rather small, trapezoidal, with broadly excised posterior border and the sides straight in the middle and rounded anteriorly. Cheeks with an oblique impression. Eyes moderately large, vertex with three ocellus-like pits. Mandibles small, very convex, 7-toothed. Clypeus sharply carinate, its lobe very short and indistinct, hardly notched in the middle. Frontal area small, rounded anteriorly and posteriorly. Antennal scapes slightly flattened but not dilated at the base, gradually enlarged distally and extending about $\frac{1}{3}$ their length beyond the occipital border of the head. Thorax narrow and low, laterally compressed behind, its dorsal outline in profile rather evenly convex, but with the base of the epinotum feebly concave. The base is twice as long as the declivity into which it passes through a distinct obtuse angle. Mesonotum present but bounded by feeble sutures; promesonotal suture strongly impressed. Petiole small, oval, as high as the epinotal angle, convex in front, flat behind, with entire, rounded, moderately sharp border. Gaster elongate elliptical. Legs slender, middle and hind tibiae slightly compressed, distinctly grooved, without a row of bristle on their flexor surfaces.

Shining; mandibles coarsely punctate, shagreened and subopaque at the base. Head subopaque, densely punctate in front, shagreened behind; clypeus and cheeks more shining, covered with sparse, elongate, shallow, piligerous foveolae. Thorax, petiole, gaster, and legs very finely shagreened and covered with small, sparse, piligerous punctures.

Hairs yellow, long, erect, and sparse on the body, shorter on the gula, longest on the gaster. Scapes with a few erect hairs at their tips. Legs and especially the tibiae with very short, stiff, oblique hairs. Cheeks and clypeus with a number of somewhat longer, suberect hairs. Pubescence yellow, rather long, dilute, very distinct on the gaster and corners of the head, almost lacking on the thorax, indistinct on the antennal scapes.

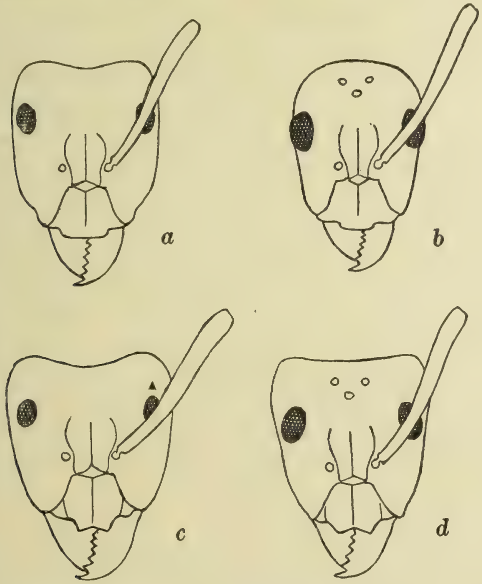


Fig. 1. *Camponotus* (*Myrmoturba*) *conspicuus* F. Smith, *a*, head of *worker maxima*, *b*, head of female, *c*, head of *worker maxima* of *C.* (*Myrmothrix*) *hannani* Forel, *d*, head of female.

Yellowish red; head a little darker, legs slightly paler; mandibles and antennae dark red, the former with black teeth; anterior border of clypeus and cheeks black. Gaster with an ill-defined brown band across the posterior portion of each segment.

Worker minima. Length 5–6 mm.

Head $1\frac{2}{5}$ times as long as broad, as broad through the anterior orbits as at the anterior border, constricted behind the eyes but with rounded sides to the occiput; the articular border short and nearly straight. Eyes rather large and convex, their anterior orbits at the middle of the head. Clypeus carinate, with broad, rather rounded anterior lobe. Antennae slender; scapes terete, extending half their length beyond the occipital border of the head. Thorax slender and low. Petiole and legs like those of the *maxima.*

Sculpture, pilosity, and color as in the *maxima* with the following exceptions:— head smooth and shining like the thorax and of the same color; scapes covered with very short subappressed hairs.

Female. (Fig. 1b). Length 10–12 mm.; wings 9 mm.

Head very narrow, nearly $1\frac{1}{3}$ times as long as broad, slightly broader behind than in front, with rather straight sides and occipital border. Clypeal lobe rectangular, longer than in the *maxima,* with straight, entire border. Eyes large and convex. Antennae like those of the *maxima* but shorter though extending half their length beyond the occipital border. Thorax long and narrow, regularly elliptical, somewhat broader than the head; mesonotum longer than broad; epinotum evenly rounded, without distinct base and declivity. Petiole like that of the *maxima,* its border entire. Gaster long and narrow.

Sculpture, color, and pilosity as in the *maxima,* the erect hairs on the thorax shorter. Wings pale yellow, with yellow veins and pterostigma.

Male. Length 5–6 mm.

Head, including the eyes, very nearly as broad as long, cheeks straight, slightly converging in front, occipital region broadly rounded. Mandibles small, slender, edentate. Clypeus distinctly carinate, with distinct, entire anterior lobe. Antennae slender, their scapes reaching nearly $\frac{2}{3}$ their length beyond the posterior border of the head. Eyes and ocelli large and prominent. Thorax broader than the head, mesonotum as broad as long. Epinotum convex, sloping, without distinct base and declivity. Petiole thick and low, higher behind than in front, its dorsal surface flattened, subrectangular when seen from above, nearly twice as broad as long and a little broader behind than in front. Gaster, genital appendages, and legs slender.

Smooth and shining, ocellar region and in some specimens the mesonotum more opaque.

Pilosity and pubescence similar to those of the worker, but antennal scapes nude and tibiae with delicate oblique hairs.

Color entirely yellowish red in some specimens, in others yellowish brown, with the occipital portion of the head and segmental bands on the gaster dark brown, the disc of the scutellum and three vague bands on the mesonotum pale brown. Wings colored like those of the female.

Described from numerous specimens of all four phases from Liguanea Plain (Brues), Montego Bay (Amer. Mus. Coll.), Kingston (Forel), and Port Henderson (Paulmier).

It seemed advisable to describe this ant in detail as it has never been adequately described and as its taxonomic status seems to be doubtful. Its identification has been accepted on Forel's authority, but when we turn to Smith's brief description of *Formica conspicua,* based on a female specimen from Jamaica, it is by no means certain that Forel's interpretation is correct. Smith says that his specimen measures 5–5.5 lines and is "chestnut red; the head about the same width as the thorax, slightly excavated behind; the clypeus subcarinate in the middle, its anterior margin slightly but widely emarginate; mandibles strong, punctured and armed with four or five teeth." The petiolar scale is "wide, ovate, with the margin entire." Now several points in this description, such as the size, strong mandibles, and the shape of the clypeus fit the female of *C. hannani* Forel much better than the form he identified as *conspicuus,* although this is not true of the petiole. Mayr, who in 1884 examined Smith's type in the British Museum, says only that it is "ein Camponotus mit abstehend behaarten Tibien." This would also agree with the long tibial pilosity of *hannani,* especially as he would hardly single out the very short tibial hairs of Forel's *conspicuus* as a noteworthy character. It seems probable, therefore, that Forel's *hannani* is a synonym of Smith's *conspicuus* and that Forel's *conspicuus* should be renamed, but as this can be decided only by comparison of both species with Smith's type, I accept Forel's interpretation provisionally.

*35. *Camponotus* (*Myrmoturba*) *maculatus* Fabr. subsp., *jamaicensis,* subsp. nov.

Worker maxima. (Fig. 2 *a, c*). Length 7.5–8.5 mm.

Head large, trapezoidal, longer than broad, with rather straight sides and broadly excavated occipital border. Eyes small, feebly convex. Mandibles 5–6 toothed. Clypeus strongly carinate, its anterior lobe rather well-developed, rounded on the sides and feebly and narrowly emarginate in the middle. Antennae slender, scapes not compressed, surpassing the posterior corners of the head by about $\frac{1}{5}$ their length. Thorax slender, in profile rather low and long, compressed posteriorly, the dorsal surface evenly convex, the base of the epinotum nearly twice as long as the declivity into which it passes through a distinct angle. Petiole small and narrow, higher than broad, with convex anterior and flat posterior surface, the border moderately sharp, rounded on the sides, slightly truncated in the middle above or even somewhat conical. Gaster rather small and narrow. Legs slender; tibiae neither compressed nor grooved, the posterior pairs without a series of bristles on their flexor surfaces.

Mandibles shining, coarsely and somewhat densely punctate, substriate near the base. Head opaque, with only the anterior corners shining, densely punctate, with the sides, posterior corners and the clypeus evenly covered with scattered, shallow piligerous punctures. Thorax and petiole opaque, more finely and densely punctate than the head. Gaster rather shining, finely, transversely shagreened and with sparse piligerous punctures.

Hairs fulvous, erect, rather long and abundant on the dorsal and gular surfaces of the head, thoracic dorsum, petiolar border, and gaster. On the vertex and sides of the head, epinotum and upper surface of the gaster there are also short, sparse, appressed hairs, representing a very coarse, sparse pubescence. Antennal scapes with denser and finer, subappressed hairs or pubescence. Legs covered with similar but longer and stiffer hairs especially conspicuous on the tibiae.

Mandibles dark red with black teeth and bases or black throughout; head black, its posterior fifth often rich reddish brown. Thorax and gaster dark brown, the sutures of the former, posterior segmental borders of the latter and the petiole brownish yellow or yellowish brown. Antennal scapes and base of first funicular joint black, remainder of funiculus dull fulvous. Legs brownish yellow, the femora sometimes darker.

Worker minima. (Fig. 2 *b*). Length 4.5–5.5 mm.

Head about $\frac{1}{3}$ longer than broad, a little broader in front than at the level of the eyes, with straight sides and rounder, converging postocular borders. Mandibles with 6 subequal teeth. Clypeus sharply carinate, the anterior border rounded and entire, its edge indistinctly crenulate. Antennae slender; scapes reaching about half their length beyond the posterior border of the head. Thorax and petiole like those of the *maxima.*

Sculpture, pilosity, and color much as in the *maxima* but the head is entirely dark brown like the thorax and the hairs on the body and appendages are somewhat shorter.

Male. Length 5 mm.

Head small and narrow, a little broader behind than in front, rounded and convex behind with straight cheeks as long as the very convex eyes. Antennae slender. Epinotum evenly convex and sloping, without distinct base and declivity. Petiole thick, with very blunt, transverse, entire dorsal surface.

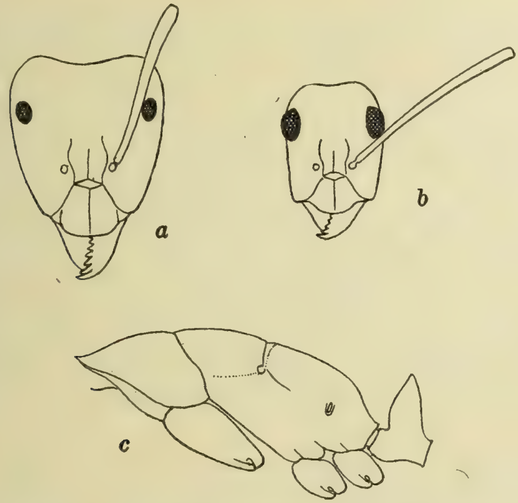


Fig. 2. *Camponotus* (*Myrmosaga*) *maculatus* Fabr. subsp. *jamaicensis* subsp. nov. *a*, head of *worker maxima*, *b*, head of *worker minima*, *c*, thorax and petiole of *worker maxima* in profile.

Head and thorax opaque, densely punctate. Petiole and gaster shining, shagreened.

Pilosity as in the worker; the long, erect hairs most abundant on the gaster.

Nearly black; antennal funiculi, mandibles, legs, sutures of thorax, tibiae, and tarsi brown, femora darker. Wings slightly tinged with brown anteriorly; veins and pterostigma pale brown.

Described from several specimens from Newton, 3,000 ft. (type locality); Liguanea Plain (Brues) and Mandeville (A. E. Wight).

This form approaches the subspecies *picipes* Olivier and especially its variety *pilosulus* Forel. In pilosity it is much like the typical *picipes* but is smaller and the surface of the body is more opaque and the head of the *maxima* has the sides more nearly straight. It resembles *pilosulus* in size but the latter is much more pilose and has the antennal scapes covered with suberect hairs, its head is shaped like that of *picipes* and the surface of the body is shining. In the male *jamaicensis* the head is shorter than in *picipes*, the petiole is entire above, the wings are tinged with brown, the legs are much paler and the body is less shining and not so black.

36. *Camponotus* (*Myrmothrix*) *hannani* Forel. (Fig. 1 *c* and *d*).
☿ ♀.— Newton, 3,000 ft.; Liguanea Plain.

The female measures 12.5 mm., its wings 14 mm. It closely resembles the *maxima* in color, sculpture, and pilosity but the head is smaller, with straight sides and nearly straight posterior border. The antennal scapes are narrower and less flattened, the upper border of the petiole is sharp and rather deeply notched in the middle and the posterior portion of each gastric segment is darker than the remaining surface. The thorax is elongate, elliptical, not broader than the head, the epinotal declivity is vertical and twice as long as the base. The mesonotum and scutellum are very smooth and shining, their erect hairs shorter than those of the worker. The wings are strongly tinged with yellow and the veins and pterostigma are resin-colored.

37. *Camponotus* (*Myrmobrachys*) *capperi* Forel. (Fig. 3, *a*).

Forel places this species in his subgenus Myrmothrix, but it seems to belong more properly in Myrmobrachys. In the typical *capperi* as I find from examination of two cotypes received from Professor Forel, the base of the epinotum is distinctly concave, with the epinotal angle pronounced, so that the thorax is much like that of many Malagasy and Australian species of Myrmosaga. The antennal scapes are naked, save for a few erect hairs at their tips, and the tibiae have short appressed hairs on their flexor surfaces.

*38. *Camponotus* (*Myrmobrachys*) *capperi* var. *formosulus*, var. nov.

Worker. (Fig. 3 *d*). Length 4.5–5.5 mm.

Differing from the typical form in the shape of the head, which is more elliptical in the larger workers, with more convex sides, in having the base of the epinotum perfectly straight and horizontal in profile, the petiole red like the gaster instead of black like the head and thorax, and each gastric segment with a more distinct fuscous band in front of the pale yellow posterior margin. The funiculi and femora are red, the tarsi, tibiae, and knees darker as in the typical form. There is little difference in pilosity, except that the gaster of the new variety has longer and more numerous erect hairs in addition to the long, dense pubescence.

Male. Length 4–4.5 mm.

Head through the eyes as broad as long, with straight, subparallel cheeks and semicircular postocular region. Mandibles edentate. Clypeus carinate, with entire, rounded and somewhat projecting anterior border. Thorax robust; mesonotum large and protuberant, overarching the pronotum, broader than long. Petiole short, thick and low, its dorsal surface impressed in the middle. Gaster rather broad.

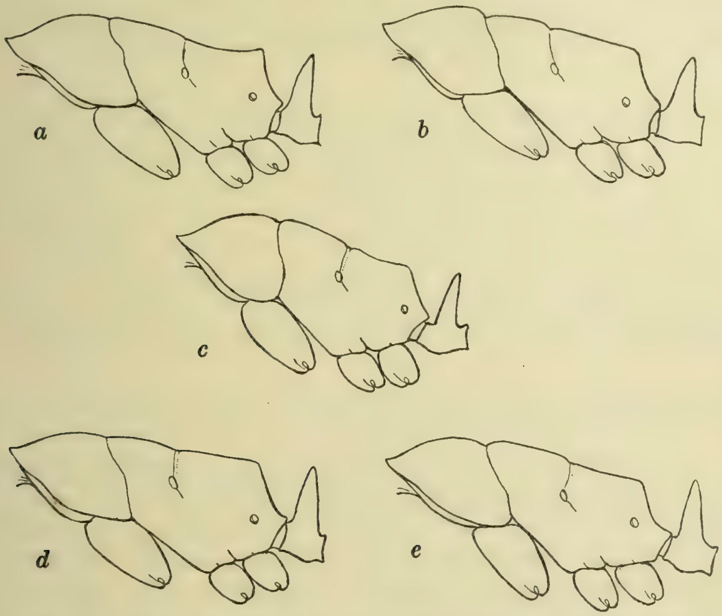


Fig. 3. *a*, *Camponotus* (*Myrmobrachys*) *capperi* Forel, thorax and petiole in profile; *b*, same of subsp. *corticalis* Forel, *c*, of subsp. *unctulus* subsp. nov., *d*, of var. *formosulus* var. nov., *e*, of subsp. *subdepilis* Wheeler.

Mandibles shining, punctate; head and thorax opaque, densely and finely punctate as in the worker; epinotum, petiole, and gaster very finely punctate-shagreened and shining.

Hairs pale, erect, very sparse on the head and thorax, more abundant on the gaster; pubescence yellowish, on the gaster much as in the worker, long and dense and nearly concealing the surface.

Black; mandibles, funiculi, legs, petiole, and gaster reddish brown; wings dull brownish hyaline, with brown veins and pterostigma.

Described from numerous specimens taken by Mr. A. E. Wight at Troy (type locality), Mandeville, and Balaclava. Those from Mandeville were attending membracid nymphs. In my 1911 list of Jamaican ants I referred this form to the typical *capperi*, but it undoubtedly represents a distinct variety or, perhaps, even a subspecies.

39. *Camponotus* (*Myrmobrachys*) *capperi* subsp. *corticalis* Forel.

In this subspecies (Fig. 3 *b*), of which I have examined three cotypes taken by Forel at Kingston, the thorax is like that of the var. *formosulus*, except that the mesoëpinotal suture is more deeply impressed. The color is different, the head, thorax, and gaster being black, the antennae, legs, and petiole red, the antennal scapes and tibiae have numerous suberect hairs and the pubescence on the gaster is much shorter and sparser so that the shining surface is clearly visible.

40. *Camponotus* (*Myrmobrachys*) *capperi* subsp. *subdepilis* Wheeler.

☿.— Port Antonio, Troy, and Balaclava (A. E. Wight).

This form (Fig. 3 *e*), described as a variety of *corticalis*, evidently deserves to rank as a subspecies. The head of the *major* worker is longer, more elliptical and with more convex occiput; the epinotum is shaped like that of the subsp. *corticalis*, but the mesoëpinotal suture is less impressed. The erect hairs on the body are much less numerous and lacking on the scapes and tibiae. The color and sculpture are similar, but the gaster is somewhat more shining and the petiole is darker.

*41. *Camponotus* (*Myrmobrachys*) *capperi* subsp. *unctulus*, subsp. nov.

Worker. (Fig. 3 *c*). Length 4.5–6 mm.

Head of the *maxima* much as in the typical *capperi*, subtrapezoidal, with the sides and posterior margin feebly convex. Thorax differing from that of all the preceding forms of *capperi* in being shorter, more convex anteriorly, with the epinotum lower and much more compressed laterally. Base of epinotum distinctly concave in profile as in the typical *capperi*, and the promesonotal suture deeply, the mesoëpinotal suture not impressed. The petiole is also thinner.

Sculpture, color, and pilosity much as in *subdepilis*, but the head and thorax are less opaque, the promesonotal suture very shining and the petiole black like the head, thorax, and gaster.

Female (deälated). Length 8 mm.

Long and slender. Head subopaque and densely and finely punctate, clypeus and cheeks with scattered, shallow piligerous foveolae, thorax and gaster shining, mesonotum with a few coarse punctures or foveolae. Petiole with the upper margin notched in the middle. Pilosity and pubescence even sparser than in the worker, the pubescence on the gaster very short. Black; clypeus, cheeks, antennae, legs, pro- and mesosterna red.

Described from a single female and 44 workers belonging to a single colony taken by Professor Brues at Newton, 3,000 ft.

TAXONOMIC PAPERS ON JAMAICAN ANTS.

1892. André, Ernest. Matériaux myrmécologiques. Rev. ent., 1892, **11**, p. 45–56.

1893. André, Ernest. Description de quatre espèces nouvelles de fourmis d'Amérique. Rev. ent., 1893, **12**, p. 148–152.

1899–1900. Forel, A. Biologia Centrali-Americana. Hymenoptera. **3**. Formicidae, 1899–1900, 169 pp., 4 pls.

1902. Forel, A. Quatre notices myrmécologiques. Ann. Soc. ent. Belg., 1902, **46**, p. 170–182.

1907. Forel, A. Formiciden aus dem Naturhistorischen museum in Hamburg. Teil. 2. Mitth. Naturh. mus. Hamb., 1907, **24**, p. 1–20.

1912. Forel, A. Formicides Néotropiques. Parts 1–6. Ann. Soc. ent. Belg., 1912, **56**, p. 28–49. Mém. Soc. ent. Belg., 1912, **19**, p. 179–209, 211–237; **20**, p. 1–32, 33–58, 59–92.

1858. Smith, Fred. Catalogue of hymenopterous insects in the collection of the British museum. Part 6. Formicidae, London, 1858.

1908. Wheeler, W. M. The ants of Jamaica. Bull. Amer. mus. nat. hist., 1908, **24**, p. 159–160.

1911. Wheeler, W. M. Additions to the ant-fauna of Jamaica. Bull. Amer. mus. nat. hist., 1911, **30**, p. 21–29.

1913. Wheeler, W. M. Ants collected in the West Indies. Bull. Amer. mus. nat. hist., 1913, **32**, p. 239–244.

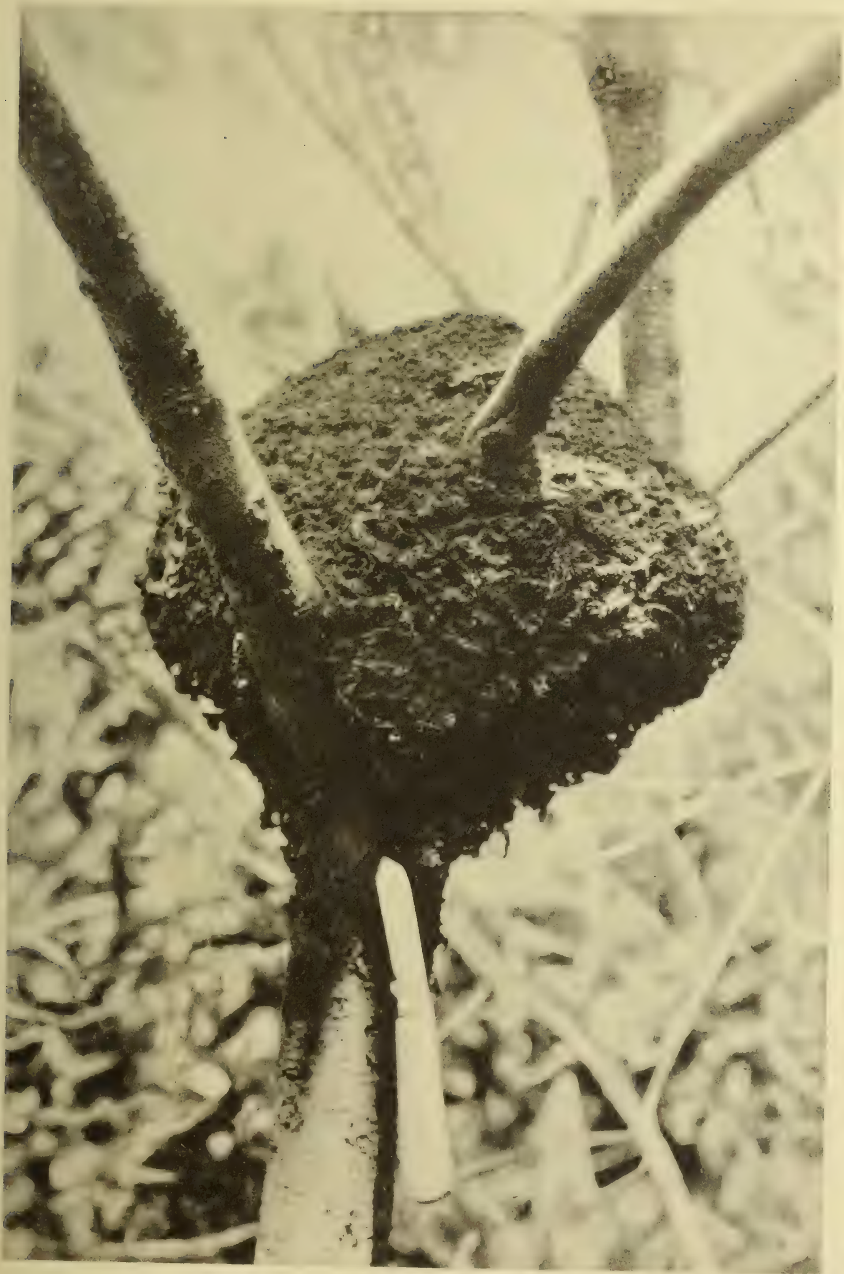
EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

Carton nest of *Crematogaster brevispinosa* Mayr subsp. *vicina* Ern. André. About $\frac{2}{5}$ natural size.

Photograph by Prof. C. T. Brues.



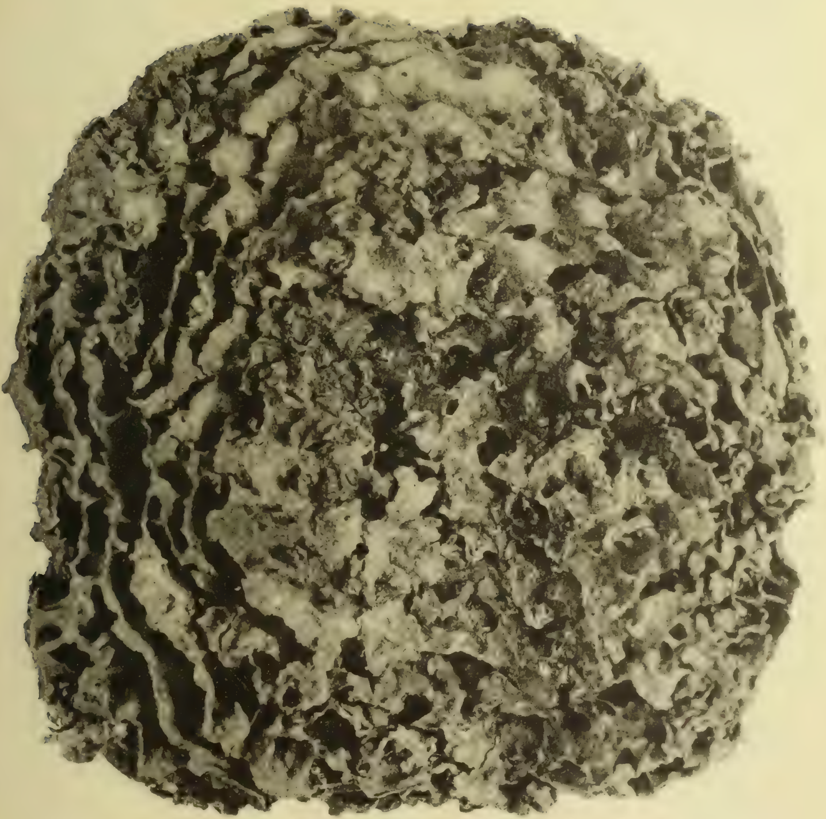
HELIOTYPE CO. BOSTON

PLATE 2.

PLATE 2.

Carton nest of *Crematogaster brevispinosa* Mayr subsp. *vicina* Ern. André. Natural size, in section.

Photograph by Prof. C. T. Brues.



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S. HENSHAW. The Insects.
G. W. MÜLLER. The Ostracods.
MARY J. RATHBUN. The Crustacea Decapoda.
G. O. SARS. The Copepods.
L. STEJNEGER. The Reptiles.
T. W. VAUGHAN. The Corals, Recent and Fossil.
A. WETMORE. The Mammals and Birds.

PUBLICATIONS
OF THE
MUSEUM OF COMPARATIVE ZOÖLOGY
AT HARVARD COLLEGE.

There have been published of the BULLETIN Vols. I. to LIV., LVI., and Vols. LVIII. to LX.; of the MEMOIRS, Vols. I. to XXXIV., and also Vols. XXXVI. to XXXVIII., XL. to XLII., XLIV., and XLVI.

Vols. LV., LVII., LXI. and LXII. of the BULLETIN, and Vols. XXXV., XXXIX., XLIII., XLV., XLVII., to XLIX. of the MEMOIRS, are now in course of publication.

The BULLETIN and MEMOIRS are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by students and others in the different Laboratories of Natural History, and of work by specialists based upon the Museum Collections and Explorations.

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Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

Contributions from the Geological Laboratory, Professor R. A. Daly, in charge.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Mass.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LXI. No. 10.

A NEW SPECIES OF PERIPATUS FROM THE MOUNTAINS OF NORTHERN PERU.

By Charles T. Brues.

With One Plate.

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM.
September, 1917.

REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUTENANT COMMANDER L. M. GARRETT, U. S. N., COMMANDING, PUBLISHED OR IN PREPARATION: —

A. AGASSIZ. V.[5] General Report on the Expedition.
A. AGASSIZ. I.[1] Three Letters to Geo. M. Bowers, U. S. Fish Com.
H. B. BIGELOW. XVI.[16] The Medusae.
H. B. BIGELOW. XXIII.[23] The Siphonophores.
H. B. BIGELOW. XXVI.[26] The Ctenophores.
R. P. BIGELOW. The Stomatopods.
O. CARLGREN. The Actinaria.
R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
H. L. CLARK. The Starfishes.
H. L. CLARK. The Ophiurans.
S. F. CLARKE. VIII.[8] The Hydroids.
W. R. COE. The Nemerteans.
L. J. COLE. XIX.[19] The Pycnogonida.
W. H. DALL. XIV.[14] The Mollusks.
C. R. EASTMAN. VII.[7] The Sharks' Teeth.
S. GARMAN. XII.[12] The Reptiles.
H. J. HANSEN. The Cirripeds.
H. J. HANSEN. XXVII.[27] The Schizopods.
S. HENSHAW. The Insects.
W. E. HOYLE. The Cephalopods.
W. C. KENDALL and L. RADCLIFFE. XXV.[25] The Fishes.
C. A. KOFOID. III.[3] IX.[9] XX.[20] The Protozoa.
C. A. KOFOID and J. R. MICHENER. XXII.[22] The Protozoa.
C. A. KOFOID and E. J. RIGDEN. XXIV.[24] The Protozoa.
P. KRUMBACH. The Sagittae.
R. VON LENDENFELD. XXI.[21] The Siliceous Sponges.
R. VON LENDENFELD. XXIX.[29] Hexactinellida.
G. W. MÜLLER. The Ostracods.
JOHN MURRAY and G. V. LEE. XVII.[17] The Bottom Specimens.
MARY J. RATHBUN. X.[10] The Crustacea Decapoda.
HARRIET RICHARDSON. II.[2] The Isopods.
W. E. RITTER. IV.[4] The Tunicates.
B. L. ROBINSON. The Plants.
G. O. SARS. The Copepods.
F. E. SCHULZE. XI.[11] The Xenophyophoras.
HARRIET R. SEARLE. XXVIII.[28] Isopods.
H. R. SIMROTH. Pteropods, Heteropods.
E. C. STARKS. XIII.[13] Atelaxia.
TH. STUDER. The Alcyonaria.
JH. THIELE. XV.[15] Bathysciadium.
T. W. VAUGHAN. VI.[6] The Corals.
R. WOLTERECK. XVIII.[13] The Amphipods.

[1] Bull. M. C. Z., Vol. XLVI., No. 4, April, 1905, 22 pp.
[2] Bull. M. C. Z., Vol. XLVI., No. 6, July, 1905, 4 pp., 1 pl.
[3] Bull. M. C. Z., Vol. XLVI., No. 9, September, 1905, 5 pp., 1 pl.
[4] Bull. M. C. Z., Vol. XLVI., No. 13, January, 1906, 22 pp., 3 pls.
[5] Mem. M. C. Z., Vol. XXXIII., January, 1906, 90 pp., 96 pls.
[6] Bull. M. C. Z., Vol. L., No. 3, August, 1906, 14 pp., 10 pls.
[7] Bull. M. C. Z., Vol. L., No. 4, November, 1906, 26 pp., 4 pls.
[8] Mem. M. C. Z., Vol. XXXV., No. 1, February, 1907, 20 pp., 15 pls.
[9] Bull. M. C. Z., Vol. L., No. 6, February, 1907, 48 pp., 18 pls.
[10] Mem. M. C. Z., Vol. XXXV, No. 2, August, 1907, 56 pp., 9 pls.
[11] Bull. M. C. Z., Vol. LI., No. 6, November, 1907, 22 pp., 1 pl.
[12] Bull. M. C. Z., Vol. LII., No. 1, June, 1908, 14 pp., 1 pl.
[13] Bull. M. C. Z., Vol. LII., No. 2, July, 1908, 8 pp., 5 pls.
[14] Bull. M. C. Z., Vol. XLIII., No. 6, October, 1908, 285 pp., 22 pls.
[15] Bull. M. C. Z., Vol. LII., No. 5, October, 1908, 11 pp., 2 pls.
[16] Mem. M. C. Z., Vol. XXXVII., February, 1909, 243 pp., 48 pls.
[17] Mem. M. C. Z., Vol. XXXVIII., No. 1, June, 1909, 172 pp., 5 pls., 3 maps.
[18] Bull. M. C. Z., Vol. LII., No. 9, June, 1909, 26 pp., 8 pls.
[19] Bull. M. C. Z., Vol. LII., No. 11, August, 1909, 10 pp., 3 pls.
[20] Bull. M. C. Z., Vol. LII., No. 13, September, 1909, 48 pp., 4 pls.
[21] Mem. M. C. Z., Vol. XLI., August, September, 1910, 323 pp., 56 pls.
[22] Bull. M. C. Z., Vol. LIV., No. 7, August, 1911, 38 pp.
[23] Mem. M. C. Z., Vol. XXXVIII., No. 2, December, 1911, 232 pp., 32 pls.
[24] Bull. M. C. Z., Vol. LIV., No. 10, February, 1912, 16 pp., 2 pls.
[25] Mem. M. C. Z., Vol. XXXV., No. 3, April, 1912, 98 pp., 8 pls.
[26] Bull. M. C. Z., Vol. LIV., No. 12, April, 1912, 38 pp., 2 pls.
[27] Mem. M. C. Z., Vol. XXXV., No. 4, July, 1912, 124 pp., 12 pls.
[28] Bull. M. C. Z., Vol. LVIII., No. 8, August, 1914, 14 pp.
[29] Mem. M. C. Z., Vol. XLII., June, 1915, 397 pp., 109 pls.

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With One Plate.

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No. 10.— *A New Species of Peripatus from the Mountains of Northern Peru.*

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION, No. 131.

By Charles T. Brues.

On a recent trip to Peru, Mr. G. K. Noble, Zoölogist of the Expedition to Peru, under the joint auspices of the School of Tropical Medicine and the Museum of Comparative Zoölogy, secured six fine specimens of Peripatus which represent an hitherto undescribed species. These were obtained at Tabaconas, near Huancabamba at an altitude of about 6000 feet. Tabaconas is on the third or eastern range of the Cordilleras less than 100 miles south of the Ecuadorian boundary and some 200 miles south of Cuenca in Ecuador where *Peripatus cameranoi* was discovered by Festa over twenty years ago. The new species is closely related to this Ecuadorian form, and also to several others from the same region, but I feel satisfied that it is specifically distinct from all of them.

The specimens were found by Mr. Noble while searching for reptiles beneath stones along the roadside and occurred in a moderately dry locality. From observations which he made on the general fauna, he regards the area inhabited by the Peripatus as distinctly a narrow extension of the Ecuadorian region and not similar to the other Peruvian places either due east or west where he collected in travelling inland from the arid coastland.

The species falls into the group of andicolous species as defined by Bouvier and separated as the subgenus Oroperipatus by Cockerell in 1908. Since then Oroperipatus has been elevated to generic rank by Clark. The new form may be known as:

Peripatus (Oroperipatus) peruvianus, sp. nov.

Size and form. All of the females, four in number are rather stoutly built, broadest just before the middle and gradually narrowed behind. They range in width from 7.5 to 9.0 mm., but as they are undoubtedly somewhat contracted, must have been more slender in life. One is quite broad anteriorly and more slender than the others posteriorly, but the approximation of the anterior pairs of legs shows this to be due to a contraction of the anterior half of the animal. There is very little variation in length as can be seen from the following measurements of all four female specimens.

	Length	Width	Legs
Type	59.0 mm.	9.0 mm.	37 pairs
Paratype	56.0 mm.	8.0 mm.	36 pairs
Paratype	55.0 mm.	7.5 mm.	36 pairs
Paratype	61.0 mm.	8.5 mm.	37 pairs

Legs. The number of pairs of legs varies from 36 to 37 in the female, two having the former and two the latter number. In the male, as shown by two specimens there are 34 pairs. Each leg has five well-developed creeping pads, the fifth usually considerably narrower than the fourth and occasionally somewhat reduced in length, although usually almost as long as the fourth. The first is broader and the three following of about equal width as a rule, although frequently the fourth is distinctly narrower and sometimes scarcely wider than the fifth. The nephridial tubercles of the fourth and fifth pairs of legs (Fig. 1) are nearly included in the third creeping pad which is very deeply emarginate, but not completely divided by them; the fourth pad is distinctly emarginate, but not deeply excavated along its distal edge opposite the tubercle. There are four pedal papillae on each leg, very rarely five in three of the four specimens, while the fourth shows on a considerable number of the anterior legs five well-developed papillae. The fifth papilla is rarely as large as the others, and sometimes occurs between the pair on the anterior or posterior edge of the foot, or either above or below them. Bouvier has regarded the presence of extra papillae on certain legs as a specific character, but it is evident at least in the case of the

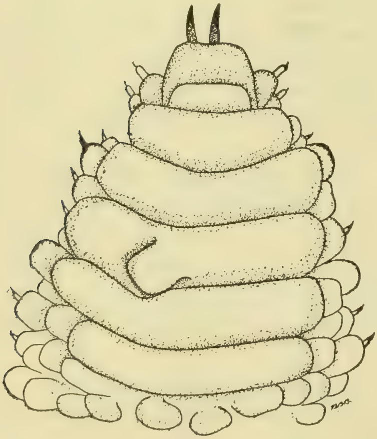


Fig. 1.— *Peripatus peruvianus* Brues. Nephridial tubercles of the fourth pair of legs.

present form that it must represent, to some extent at least, individual variation. While I cannot be sure that more of the examples show no legs with five papillae, it is very evident that one of them differs quite conspicuously from the others in this respect.

Integument. On each body-segment there are two body-folds which are incomplete, terminating about halfway between the median line and the base of the legs. The alternate body-folds differ slightly but regularly in width. This difference is slight and might easily be overlooked, but their papillae accentuate the variation since the larger papillae of alternate folds vary considerably in size. Thus on the broader folds the largest papillae are nearly twice as large as those on the narrower folds although there is practically no difference in the size of the small primary papillae on alternate folds. The largest papillae have an evenly rounded or slightly transversely oval base and are about as high as broad, with their nipple-shaped apex short and acute. The smaller primary papillae number most commonly three between a pair of large ones; not infrequently however, especially on the narrower folds only two occur; very rarely there are four, and occasionally five, in which case the middle one is nearly always markedly enlarged and the arrangement approaches that where there are two small ones between a pair of large ones. Aside from this very sparse scattering of medium sized papillae there is no tendency for any intergradation between large and small papillae. Accessory papillae are almost entirely absent; most of the body-folds show none at all, and an occasional fold one or two of very small size toward the edge of the fold.

Color. In life, according to Mr. Noble, the body is uniformly deep brown in color with a distinct yellowish band forming a collar behind the antennae. After nearly a year in alcohol, the band has lost its original color and shows as a paler area, almost white and very conspicuous in one specimen, and less noticeable in the others; in one especially, it is only slightly evident. It is quite broad, including from 17 to 23 body folds. The alcoholic specimens have also developed quite conspicuous body-markings which show as a zig-zag line extending along each side of the body halfway between the legs and median line, the angulations extending laterally opposite each leg and medially between the legs. Sometimes a distinct dark streak extends downward toward each leg. Between the darker markings and excepting the dark dermal papillae, the integument is greatly bleached and is of a dirty yellowish lilac tinge both above and below and on the legs.

Mandibles. (Fig. 2.) The mandibles have two well-developed accessory teeth and a less prominent but more heavily chitinized third one. The blade bears seven or eight denticles, the last two or three of the series much smaller in size.

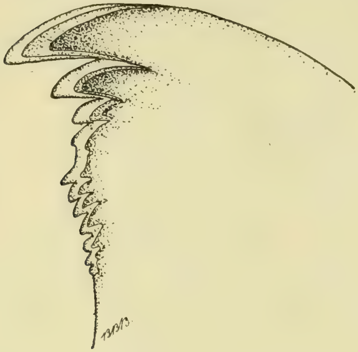


Fig. 2.— ***Peripatus peruvianus*** **Brues. Mandible.**

Type. M. C. Z. 314. Described from the type, three female paratypes, M. C. Z. 315–317, and two males, M.C.Z.318–319, Tabaconas, near Huancabamba, Peru, August, 1916. G. K. Noble.

Relationships. The present form is quite closely similar to several others already known from Ecuador and western Colombia, and finds a place in the group of species from this region, the members of which have been carefully studied and described by Bouvier (Ann. sci. nat. Zool., 1907, sér. 9, **2**, p. 80–119). It is, however, readily distinguishable from all of them by anatomical characters, and must I think rank as a species rather than as a subspecies, particularly as it is difficult to associate it with any single described form to the exclusion of others.

By the alternation in width of the body-folds, the presence of *five* pedal papillae on some of the legs and the large number of legs, *P. peruvianus* falls at once into the group which includes *P. ecuadorensis, P. lankesteri, P. tuberculatus, P. quitensis,* and *P. cameranoi.*

P. ecuadorensis is at once distinguished from all the others including the present new species by the absence of segmentally arranged incomplete dermal folds. It differs from *P. peruvianus* also by its more numerous legs and by the fact that smaller dermal papillae are much more numerous between each pair of large papillae. *P. lankesteri* is more difficult to separate from *E. peruvianus,* but in the arrangement of the integumentary papillae is very different. The former possess numerous accessory papillae which are almost entirely absent in the latter. *P. tuberculatus* has the accessory papillae more numerous and is consequently less like *P. peruvianus* in this respect, it differs also in possessing the rudiment of a sixth creeping pad on the foot and the presence of only four pedal papillae on all the legs. *P. quitensis* has not been very accurately described (*cf.* Bouvier, *t. c.,* p. 110), and evidently resembles the present species closely. It has however, 36 pairs of legs in the male instead of 34 and from Bouvier's figure (*t. c.* p. 111, fig. 59) the papillae are evidently of much more nearly equal size, especially on the alternately narrower dermal folds; also the nephridial tubercle of the fourth pair of legs completely bisects the third creeping pad, which is not the case in *P. peruvianus*. The last previously described species of this group *P. cameranoi* is not very well known and occurs in a part of Ecuador which is close to the portion of Peru in which *P. peruvianus* was collected. Nevertheless the two seem to be distinct. In *P. cameranoi* the primary papillae are of rather variable size, but none are remarkably larger than the others whereas in *P. peruvianus* such is by no means the case. Also the Ecuadorian species has only four creeping pads with the vestige of a fifth and the nephridial tubercle of the fourth and fifth legs bisects completely the third creeping pad.

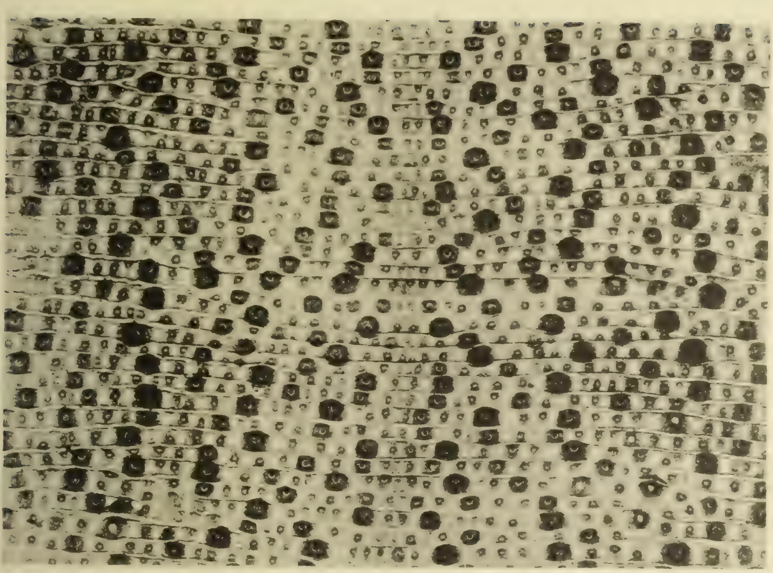
From the foregoing comparisons it appears that while *P. peruvianus* is closely related to a number of other species from the same region, it can not be regarded as conspecific with any of them.

EXPLANATION OF THE PLATE.

EXPLANATION OF THE PLATE.

Peripatus peruvianus Brues.

Fig. 1.— Integument, showing an area on each side of the median line.
Fig. 2.— A smaller area of the integument to the right of the median line.



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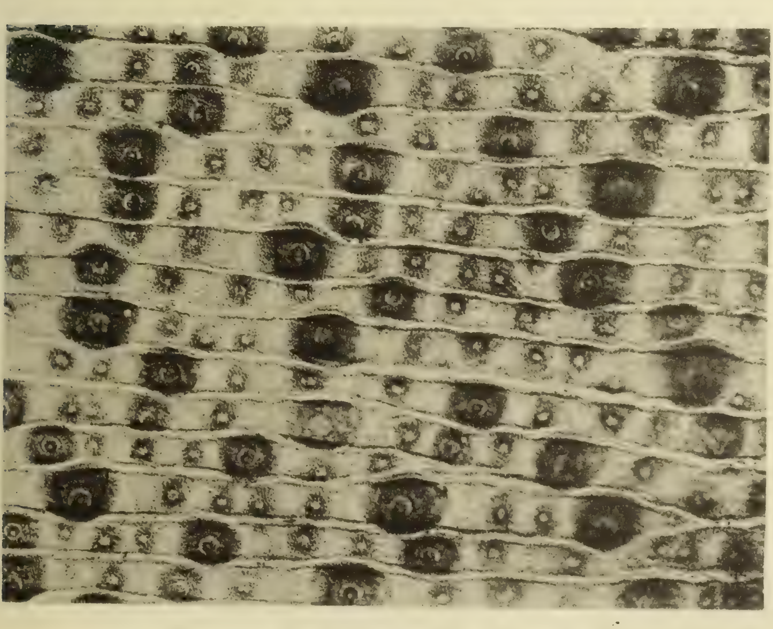

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MARY J. RATHBUN. The Crustacea Decapoda.
G. O. SARS. The Copepods.
L. STEJNEGER. The Reptiles.
T. W. VAUGHAN. The Corals, Recent and Fossil.
A. WETMORE. The Mammals and Birds.

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Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieut. Commander Z. L. Tanner, U. S. N., Commanding, in charge of Alexander Agassiz.

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Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

Contributions from the Geological Laboratory, Professor R. A. Daly, in charge.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Mass.

Observations on the Embryonic Development of the Mantid Paratenodera sinensis

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OBSERVATIONS ON THE EMBRYONIC DEVELOPMENT OF THE MANTID PARATENODERA SINENSIS[1]

HAROLD R. HAGAN

TWO TEXT FIGURES AND THREE PLATES

While engaged in the study of the general embryology of insects I became interested in a peculiar dorsal organ and the method of revolution of the large imported mantis, Paratenodera sinensis Sauss. There are many other interesting factors in the development of this insect which must be passed over in the present paper.

My sincere thanks are due to Prof. W. M. Wheeler, under whose direction this work was prepared, for his many helpful suggestions and his criticism of the text. I am also indebted to the kindness of Prof. C. T. Brues for aid in securing the illustrations.

The ootheca is deposited in September, the insect hatching the following spring. The construction of the ootheca and the emplacement of the eggs are similar to those of Mantis religiosa so well described by Giardina ('97–'00).

The earliest development of P. sinensis unfortunately cannot be presented at this time as the material was secured from Philadelphia through the mails and when received several days had elapsed between oviposition and laboratory treatment of the first oothecae. It is probable that the very earliest stages are quite similar to those of M. religiosa described by Graber ('90) and Giardina (97*b*). The latter especially has considered at length the very earliest stages including the fertilization of the egg, oviposition, cleavage and the formation of the ventral plate. My material covers succeeding stages.

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[1] Contributions from the Entomological Laboratory of the Bussy Institution, Harvard University, No. 132.

The egg. The egg is elongate-oval, with an evenly rounded posterior end and tapering slightly to a somewhat smaller, more pointed anterior end. The shape is generally cylindrical but the anterior end is usually a little compressed laterally due to the pressure of the adjoining eggs in the ootheca. Distinct though not strongly concave and convex surfaces denote the dorsal and ventral surfaces respectively. A prominent button-shaped micropyle almost covers the anterior end of the egg. The length averages 4.5 mm. and the diameter near the middle of the longitudinal axis is about 1.3 mm.

The embryonic rudiment. The ventral plate is remarkably short when compared with the size of the egg. It varies, according to a number of measurements, from 0.46 mm. to 0.59 mm. in diameter. In surface view it consists of a sharply defined circular area of closely compacted cells on the ventral side of the egg, about two-thirds the distance from the anterior pole. When the egg is viewed from the lateral aspect this area appears flattened or even as a very slight depression in the yolk.

After gastrulation the germ band elongates rapidly, involving the entire ventral plate; the anterior end develops laterally also to form the rudiments of the cephalic lobes, while the posterior end assumes a lengthened form, giving the whole a shape roughly suggesting the letter T (fig. 1). The antero-posterior axis of the germ band corresponds with the same axis of the egg and lies in the same direction. The anterior end of the embryo is directed toward the anterior end of the egg throughout its entire embryonic history. On arriving at this stage, however, the embryonic rudiment undergoes successively a number of intermediary steps. The first change noticed is the lengthening of the circular or slightly oval ventral plate with apparently a slight contraction of its width. This movement is accompanied by activity in the antero-lateral region where the cephalic lobes are beginning their development. The ventral plate at this point appears somewhat U-shaped in outline, the base of the U corresponding to the posterior end. This appearance is quickly passed because of the continued elongation of the germ band and the active growth and extension of the rudiments of the cephalic lobes.

During this time the posterior and lateral margins of the germ band undergo a folding which initiates the growth of the embryonic envelopes. This fold extends laterally forward along the edges of the germ band, and extension toward the midline of the germ band proceeds until the edges unite, forming the amnion and serosa.

Further development consists in the enlarging and rounding of the cephalic lobes, accompanied by a continuation of growth at the posterior end of the germ band. The region immediately caudal to the lobes retains its width, while after the embryonic rudiment has attained a length of about 0.6 mm. to 0.7 mm., extension posteriorly is apparently retarded slightly, and a lateral development of the posterior third of the germ band takes place. This area becomes a little wider than the middle third. In this sequence of growth we find three distinct developments; first, a marking off of an anterior third of the germ band which will subsequently give rise to the eyes, brain, antennae, etc.; second, a middle third from which the mouthparts apparently arise; third, a posterior part destined to become the thoracic region and from which the thoracic appendages are later developed. While three quite distinct regions may be observed, they cannot be considered as macrosomites in any sense, for they are identified by minor external conformations only and are not separated by any process of segmentation. The posterior termination of the thoracic region consists of a rounded area of cells whose activity will be discussed presently.

During the development just described the embryonic rudiment has lengthened from about 0.65 mm. to a little over 0.9 mm. Up to this point the entire area has revealed no differentiation in structure; there is what appears in external view simply as a peculiarly shaped homogeneous mass of cells.

The indusium. A peculiar serosal structure has been observed in this and in several succeeding stages which resembles very closely an early stage of the indusium of Xiphidium with which I think it should be homologized. According to Wheeler ('93) the indusium of Xiphidium becomes a large three-layered organ enveloping practically the entire egg. Subsequent study has not shown that in any other insect the indusium attains such development. On the other hand, we should expect this organ to be present in more or less rudimentary form in a few, at least of the other orthoptera. Indeed, such is the case in Orchelimum vulgare where the development of the organ closely approaches that of Xiphidium, while in Stagmomantis a small group of cells immediately anterior to the germ band probably represents a more rudimentary type of indusium than I figure for Paratenodera sinensis. Two well developed indusial structures have been described by Muir and Kershaw ('12) for one of the Homoptera. They find that the embryo of Siphanta acuta possesses an outer indusium adhering to the inner surface of the serosa. It completely surrounds the yolk and embryo. A second indusium is closely applied to the yolk and is fused to the edges of the amnion. It does not cover the amnion or the embryo. That the structure in the mantids has escaped notice so universally can be readily understood if it chanced to occupy a position similar to its location in P. sinensis where it is usually torn off with the embryonic envelopes while the embryo is being prepared for staining and mounting.

As early as the stage shown in figure 10 there is a very compact mass of cells lying in the serosa just above, or a little posterior to the cephalic third of the ventral plate. In the later stages (figs. 11, 12) this area is shifted posteriorly until it lies over the last mandibular or the first thoracic metamere. The cells of the serosa are very much flattened so that each covers considerable area, while the indusium remains compact and distinctly columnar as is seen in sagittal section (text fig. 2, *A*). The nuclei are uniformly situated at the bases of the cells which, at their upper ends, appear alveolar in structure and apparently are attached firmly to the vitelline membrane. This is the same stage as seen in figure 2.

It has been shown in Xiphidium that, after segmentation occurs, the embryo moves toward the posterior pole in its invagination and passage through the yolk to the dorsal surface of the egg. This movement separates the embryo from the indusium and leaves the latter free. It is only after such separation that the indusium begins its rapid growth and envelopment of the yolk. In P. sinensis the indusium is not further developed. I offer the suggestion that it is simply pulled over the embryonic rudiment as the amnio-serosal fold progresses to form the embryonic envelopes. Accepting my idea of homology, therefore, readily explains the presence of this structure and offers an explanation of its unique position in the serosa. The organ persists in place, apparently firmly attached to the vitelline membrane, until sometime after completion of revolution, when it frees itself and is ingested by the embryo during the formation of the dorsal walls. This structure is clearly not to be called the dorsal organ, though it may become part of it, as will be evident presently. Another organ later makes its appearance which answers very satisfactorily to Wheeler's ('89) definition of a dorsal organ. "The term 'dorsal organ' has been applied to the peculiar thick lump of cells resulting from the concentration on the dorsal yolk of the remains of either the amnion or serosa, or of both, preparatory to their sinking into the yolk and being absorbed."

Definitive segmentation and the appendages. Referring again to the small area of cells posterior to the thoracic region, active growth takes place as soon as the lateral development of the thoracic region has proceeded to its completion for the present, as shown in figure 2. As the definitive thoracic segments are becoming visibly outlined by the grouping of the cells, this posterior mass is rapidly developing caudally to form the abdominal segments. It is during this extension that the antennal, buccal, thoracic and abdominal rudiments first make their appearance.

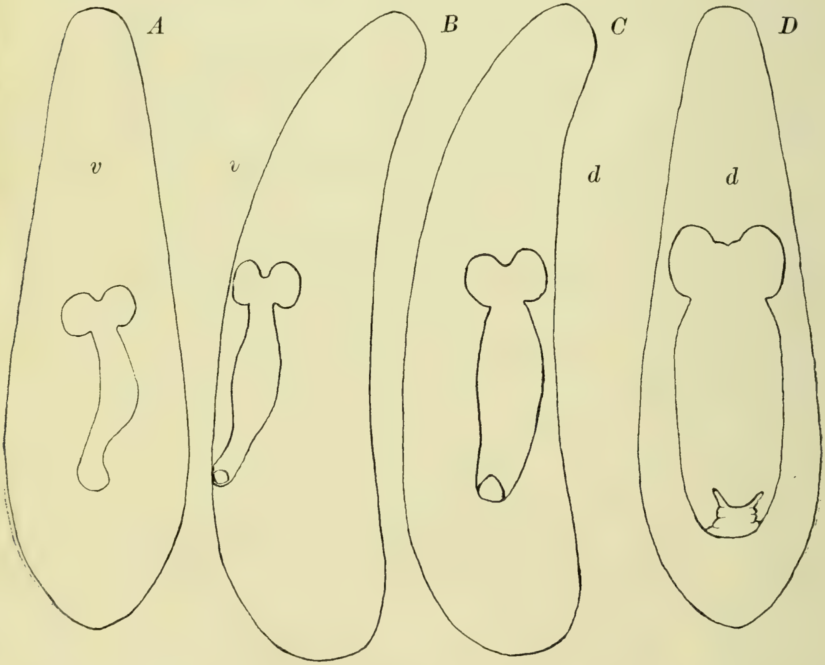
The antennal rudiments originate as the result of a rapid multiplication of cells in a rather restricted area on the hind margin of the cephalic lobes, a little less than half way between their margins and the median line. Immediately behind this area a strip of clear cytoplasm is apparent, making the antennal proliferations even more noticeable. This very rapid cell division crowds a large number of cells with little cytoplasm into a compact mass. As growth continues, the tendency is apparently a bulging of this area, and the swellings thus produced develop later into the antennae. Soon the labrum can be distinctly recognized as a conical evagination a little anterior to the proximal edges of the bases of the antennal rudiments. It is distinctly an unpaired organ, but a line of bifurcation is visible, even after the revolution of the embryo, indicating its primitive paired condition. This is also the view held by Viallanes ('90) for M. religiosa. The protuberances produced on the buccal and succeeding areas arise in a manner quite similar to those of the antennae. The development of the swellings in the thoracic region proceeds much more rapidly and they are at all times more conspicuous than those of the buccal or abdominal areas. My preparations show that the antennal rudiments appear first, followed by the rudiments of the thoracic appendages, then appear practically simultaneously the rudiments of the labrum and the maxillary appendages. This is not entirely in conformity with the views taken by Vaillanes ('90) and Giardina ('99) in their studies of Mantis religiosa.

As posterior growth of the embryo progresses, the definitive segments of the abdomen become more clearly recognized in antero-posterior sequence. By the time that the first five abdominal segments are recognizable, the terminal enlargement undergoes a change, developing into the telson, and appears ventrally flexed by the time two more segments are visible, (fig. 3). The abdominal appendages arise as evaginations in a manner analogous to the others. They consist of a pair of finger-like pleuropodia on the first abdominal segment and of merely prominent swellings on the remaining segments. The telson, however, has prominent projections which undergo marked changes during development. In Stagmomantis they are all, except the pleuropodia, much more developed, resulting in a series of bladder-like organs. The first abdominal pair consists of conical finger-like processes which are quite alike in both Paratenodera and Stagmomantis. The development of the structure of the telson I hope to make the subject of a future paper.

The stomodaeum is discernable shortly before the flexing of the telson, while the proctodaeum is visible immediately after. The median groove is now a deep furrow and corresponds with the median longitudinal axis of the embryo. In the meantime the brain has assumed a more definitive outline and the optic plates are differentiating, the nuclei becoming numerous and closely compacted to form a dark band around the lateral margins of the cephalic lobes. The tritocerebrum is recognized as a broad metamere anterior to the mandibular metamere (fig. 3).

Revolution of the embryo. Up to this point the embryo has been lying on the ventral side of the egg with its longitudinal axis in a straight line. Now a most curious movement may be observed. Its long axis suddenly becomes curved. The head and telson are still directed toward their respective ends of the egg, but the middle of the embryo is bent toward the lateral margin (text fig. 1). This movement is followed by the anterior end of the embryo moving to the side, resulting in slightly straightening the median line. The head is now pointing diagonally forward, the thoracic region still exhibiting a slight bending, while the telson alone lies in its original place. The entire embryo then passes laterally around the yolk, maintaining its superficial position, and finally comes to rest on the dorsal side of the egg, the ventral side of the embryo up, while the dorsal side retains its original proximity to the yolk. During this movement, the telson may move rapidly enough to catch up with the anterior end, causing the axis of the embryo again to coincide with that of the egg during the remainder of the migration. This is not always so, and the anterior end of the embryo frequently arrives on the dorsal line slightly in advance of the more posterior parts. At different times, during this movement, depending also largely upon the individual case, the median line of the embryo has again become straightened longitudinally. This sometimes occurs shortly after the movement is initiated. In the present study it was found that about three-fourths of the embryos passed around the right side of the egg, but this must not be considered, for the present at least, as indicating any preference in orientation, but rather as an accidental observation which might not be supported by tabulating a larger number of cases. The embryos passing around the left side of the egg presented no discoverable differences from the former class. Embryos of eggs adjoining each other in the ootheca passed around the same or opposite sides of the yolk mass indifferently. The gravitational position of the ootheca had no influence in regulating this movement as was determined by a study of a number of oothecae in various positions.

This movement was incidentally mentioned by Giardina ('00) in his general account of the development of Mantis religiosa.



Text fig. 1 Diagram to illustrate the movement of the embryo from the ventral to the dorsal surface of the egg. A, ventral yolk, Embryo with characteristic curvature which immediately precedes revolution. B, lateral aspect showing embryo about one-third around. C, same view, but embryo about two-thirds advanced to dorsal yolk. In this instance the posterior end of the embryo has moved faster than the cephalic end so that its axis is parallel with that of the egg. D, dorsal yolk. The embryo remains ventral side up until after emergence from the ootheca. *d*, dorsal surface; *v*, ventral surface of the egg.

It is unique among observed insect embryos in at least two respects: first, the embryo reaches the dorsal yolk by means of a lateral or sidewise migration instead of proceeding head first or tail first as is commonly the case: second, the embryo, after arriving in position on top of the egg, remains there for the rest of its embryonic growth and even on hatching works its way out of the ootheca from this position. The usual revolution of hexapod embryos, when such a movement occurs, is followed later by some sort of reversal during which the embryo returns to its original position.

Growth during revolution. Growth continues during the foregoing movement, and very early there can be perceived a tendency toward a general thickening of the entire embryo. It becomes broader, covering a larger proportion of the yolk; it also elongates. By the time it is in a mid-lateral position; the antennal, maxillary and thoracic appendages, instead of appearing as mere finger-like projections, have become considerably elongated and exhibit, as well, definitive segmentation, though this is far from complete. The first abdominal segment has developed a pair of elongate conical processes, which are primitive appendages. The tracheal invaginations are unusually distinct and the telson is undergoing several modifications. The abdomen shows ten definitive segments and with the telson, eleven in all. The last three are ventrally flexed.

When the embryo reaches the dorsal surface of the egg it appears as in figure 4. We note at once the rapid development that has taken place in the whole embryo and particularly in the appendages. The procephalon is clearly outlined, the optic plates are heavily pigmented and the tritocerebrum is drawn up under the procephalon. The buccal segments are likewise drawn forward into a more compact mass. The thoracic region is as broad as the cephalic area, and all of the appendages show greater or less signs of segmentation. The first abdominal appendages are still relatively long and project diagonally outward. The following pairs are certainly reduced in size. In fact they rapidly flatten out and a little later apparently form the margins of the sternites. As a result of the disappearance of these appendages as swellings it can be seen that each of the two sternites is composed of two sclerites. One is adjacent to the median furrow and the other, lateral to it, is composed of the tissue which formerly constituted the appendage. The two are separated at first by a very pronounced suture, but in succeeding stages this is gradually obliterated.

A description of the development of the appendages of the cephalic and thoracic regions would be simply a record of growth by successive slight modifications to form the nymphal structures. The chordotonal organs are now visible externally in the tibiae as deep pits, although they, too, become obsolete some time before hatching (fig. 4). The appendages entering into the formation of the gonapophyses undergo profound modifications from now on throughout embryonic development.

The dorsal organ. The growth of the dorsal body wall follows the fusion of the embryonic envelopes and their subsequent rupture immediately over the ventral surface of the embryo. An examination of the serosa at this time shows that a contraction of its cells, particularly in the region of the indusium is taking place. The fused part of the amnion and serosa contract and fold back over the margin of fusion. The continued contraction of the ventral serosa (dorsal to the embryo) pulls the remainder of the amnion back over the yolk, leaving the embryo free in the place between the dorsal yolk and the vitelline membrane. The yolk is now enclosed by the embryo in the postero-dorsal region, by the amnion on the posterior, postero-lateral and antero-dorsal areas, while the serosa covers the remainder. As the body wall now grows down over the yolk, the amnion is drawn, by contraction of the serosal cells, along the future mid-dorsal line of the embryo. Growth of the body wall proceeds from the posterior and postero-lateral edges in advance of the anterior regions. This results in fusion along the mid-dorsal line of the embryo and the completion of the tergites successively from the caudal end forward.

The contracted serosa lags behind the forward growth of the body walls and a large fold of it covers the proliferating margins of the embryo. Two peculiar organs are now apparent in the serosa, evidently taking up much of the slack in the posterior serosa and, what is perhaps even more important, they are exerting a pull on the amnion in the cephalic area which encloses a large amount of yolk which is to be ingested before closure of the mid-dorsal line. The embryo itself, in its forward growth, is assisting in forcing this mass of yolk back, as it now occupies over two-thirds of the dorsal surface of the egg. The lateral extension of the optic plates, the further differentiation of the buccal segments and nerve centres, with the consequent thickening of this whole cephalic portion of the body, tend to push the yolk back into a less crowded region of the egg.

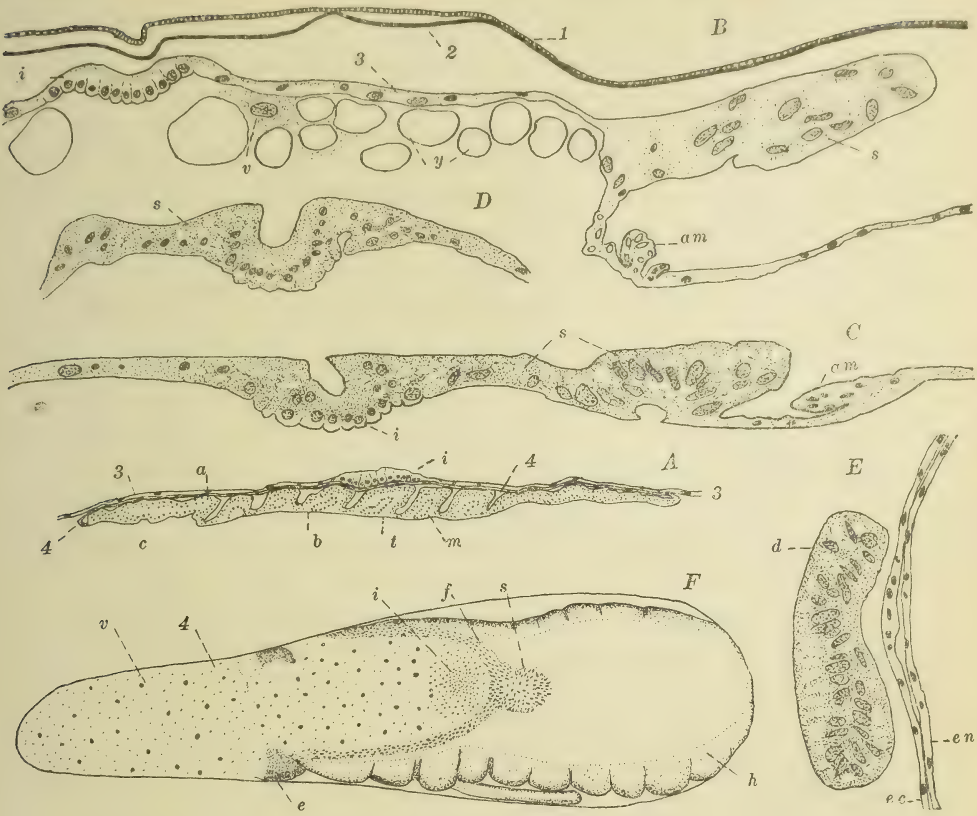
The two organs now visible in the serosa are composed of its cells each arranged like a cup around a hollow core. They are tall and columnar in section (text fig. 2, *B*, *C*, *D*, *F*). Their sole purpose is evidently to further the contraction of the serosa in order to expedite its ingestion within the body cavity with the last of the anterior yolk. The first one has the lumen opening out toward the vitelline membrane. I am convinced that this is the indusium because it has the same cellular structure, occupies the same position as maintained by the indusium in the preceding stage, and finally, because I am unable to find the indusium in any other situation. The second contraction organ is immediately posterior to the first and is composed of cells identical in appearance to those of the remainder of the serosa proper. Its lumen opens toward the dorsal wall of the embryo. As the completion of the dorsal body-wall of the embryo continues, the anterior yolk is pushed posteriorly and ingested in the dorsal thoracic region. The dorsal organ is composed of the serosa, its contraction organs and the amnion. The anterior portion of the amnion is probably the last part to be absorbed, as it immediately precedes the growth of the ectoderm and the mesoderm over the dorsal surface of the head and thorax of the embryo and the rapidity of its movement is therefore dependent upon the rate of growth of these embryonic tissues.

A late embryonic envelope. Just before hatching the embryo secretes the chitinous epidermis (fig. 9). Each of the appendages thus becomes individually incased so that they are all separated completely from actual contact with each other or with the body except at the points of articulation. This covering cannot be the vitelline membrane or the chorion, as either of these would appear as a simple sac enclosing the body and appendages. According to Phil and Nellie Rau ('13) this covering is a simple sac enclosing the embryo and binding the appendages (except the prothoracic legs) to the body. They suggest that the first pair of legs, project through this envelope and are therefore free. I find that Muir and Kershaw ('12) sometime ago pointed out the common error of supposing this cuticle to be amniotic in origin. This membrane exhibits ridges, pits and spines on its exterior surface due to the conformations of the hypodermis which secretes it. The front of the head is produced considerably to form an organ which aids by its alternate contraction and expansion, in the escape of the animal when hatching and emerging from the ootheca. In function it is clearly analgous to the ptilinum of the higher Diptera. Over this area the envelope is very materially thickened, possibly for protective purposes. At the posterior end the tips of the envelope covering the cerci are connected, each by a slender thread, to the egg membranes.

The first ecdysis. Hatching is accomplished by alternately contracting the dorsal and ventral parts of the body with a sort of undulatory motion. Shortening the ventral surface pulls forward the dorsal segments, and reversing the movement advances the ventral parts and the appendages. The return of the segments to their former positions is prevented by their strongly chitinized hind margins and the posteriorly directed spines and bristles, particularly on the legs and cerci. At this time the partially flexed portion of the abdomen becomes straightened posteriorly.

After hatching, the insect is suspended by the two threads attached to the posterior part of the epidermis. While hatching it has increased in length and, almost as soon as it is hanging

Text fig. 2 The dorsal organ and the indusium. A, sagittal section of the embryonic rudiment through the appendages and the indusium. This stage is a little later than that of figure 2. The embryonic envelopes are slightly diagramatic, being shortened and not following the outlines of the embryonic rudi-



ment. × 65. B, the indusium, sagittal section, at a stage corresponding to those of figures 7 and 8. The dorsal organ is forming. × 127. C, the dorsal organ in sagittal section at a slightly later stage. The amnion covering the anterior yolk is yet to be added. This stage is figured in surface view in figure F. The indusium seems to have a definite function for the first time in its accumulation of a large amount of serosal protoplasm for ingestion × 144. E, the indusium in cross section. Same stage as figure C × 100. E, cross section through the posterior portion of the serosal contraction organ of figure C. The ectoderm and endoderm of the dorsal wall of the embryo are clearly distinguished. × 110. F, ventral surface of the egg showing anterior yolk, the formation of the dorsal organ and the growth of the dorsal walls of the embryo. × 21.

A, antennal rudiment; *am*, amniotic protoplasm; *b*, second maxillary rudiment; *c*, cephalic region; *d*, dorsal organ; *e*, eye; *ec*, ectoderm; *en*, endoderm; *f*, lateral folds of serosa; *h*, chitinous secretion; *i*, indusium; *m*, mesoderm; *s*, serosal protoplasm; *t*, prothoracic limb rudiment; *v*, vitellophag; *y*, yolk; *1*, chorin; *2*, vitelline membrane; *3*, serosa; *4*, amnion.

free from the ootheca, it is able to rupture the membrane which has now become too small for it. A longitudinal slit occurs over the prothorax which is literally "popped" out through it. Observers of this phenomonon have uniformly described the humped position of the embryo as the cause of the rupture of the cuticle. My study has led me to the conclusion that we are dealing merely with an attitude of the body as a result of the dorsal split in the cuticle which permits the protrusion of the prothorax through the opening. Continued movements, not only of the body walls but also of the body fluids, force more and more of the animal through this slit. The prothorax is greatly elongated by this means and appears as a hump or loop over the head and thorax. Alternating saw-like movements of the limbs soon release the head and thoracic regions; then the envelope is worked backward off from the abdomen and the limbs are freed in succession. The abdomen is entirely uncovered before the tarsi of the metathoracic legs. In thirty to fifty minutes after suspension the nymph is running about actively and is approximately three times the length of the egg from which it hatched.

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PLATE 1

EXPLANATION OF FIGURES

1 Embryonic rudiment showing the indusium in the serosa. × 22.

2 Slightly later stage showing the cephalic, buccal and thoracic regions and the posterior extension which later developes into the definitive abdominal segments. × 25.

3 The optic plate, labrum and antennae are sharply defined as are also the following appendages back to the fifth abdominal segment. The telson is flexing ventrally. The tritocerebral area is visible beneath the antennae. The stomodaeum and proctodaeum have made their appearance. This stage is slightly earlier than figure 13. × 26.

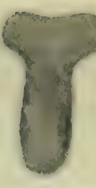
4 A considerable later stage. The tritocerebral area and also the buccal region are drawn up more nearly into position. The spiracles are plainly visible even earlier than this. The chordotonal organs are indicated as pits on the definitive tibiae. × 27.

5 Slightly older than figure 4. The abdominal appendages can no longer be seen. × 27.

6 A somewhat later stage showing the telson almost straightened. The shaded portion on the right of the figure is the dorsal wall which is now beginning to enclose the yolk. Segmentation is very distinct. × 26.

7 and 8 Succeeding stages. The condition of the embryo in its dorsal growth corresponds closely to text figure 2, *F*. 7, × 22. 8, × 26.

9 The embryo a short time before emergence. The epidermis can be seen more or less loosely adherent to the embryo particularly in the postero-dorsal region. × 14.5.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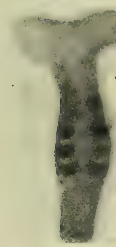
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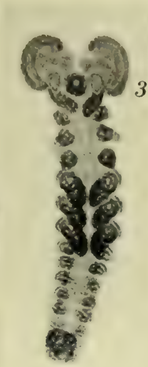
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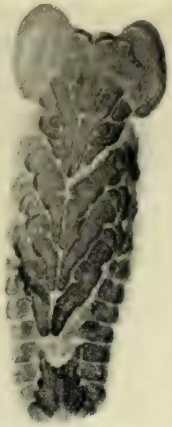
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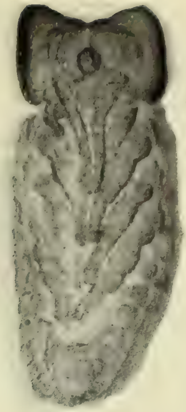
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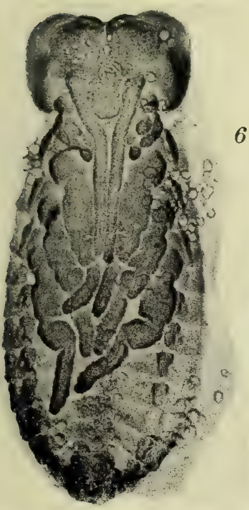
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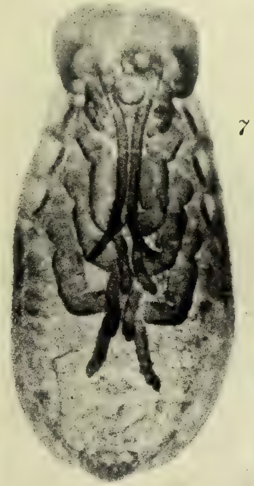
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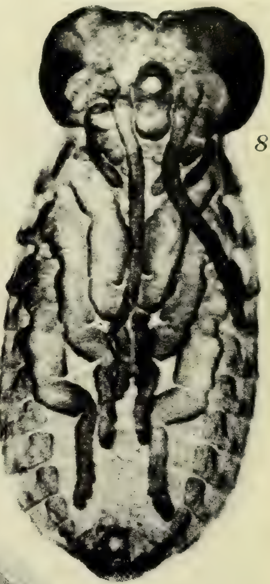
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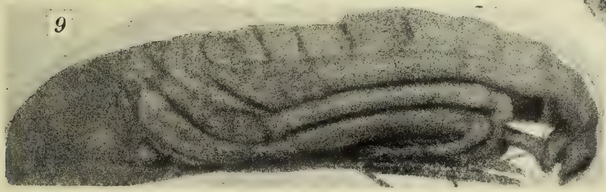

9

PLATE 2

EXPLANATION OF FIGURES

10 Surface view of ventral yolk showing the embryonic rudiment. Cephalic, mandibular and thoracic areas recognizable. × 20.

11 Same view, later stage embryo. Cephalic lobes, rudiment of appendages and abdominal growth are the characteristics of this stage. × 26.

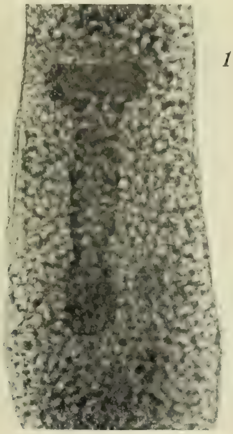
12 Same view. The peculiar bending of the embryonic axis preceding revolution to dorsal yolk. (The egg is tipped slightly to the right). × 25.

13 Lateral view showing the embryo passing around the right side of the egg. (Egg is below normal size.) × 25.

14 Lateral view. This embryo is passing around the left side of the egg. × 27.

15 Dorsal view. This stage is one shortly after the embryo has come to rest on the dorsal yolk. × 27.

10



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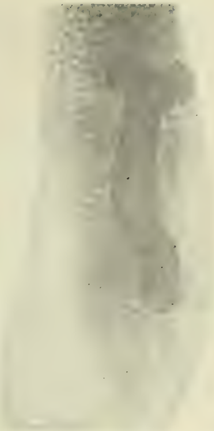

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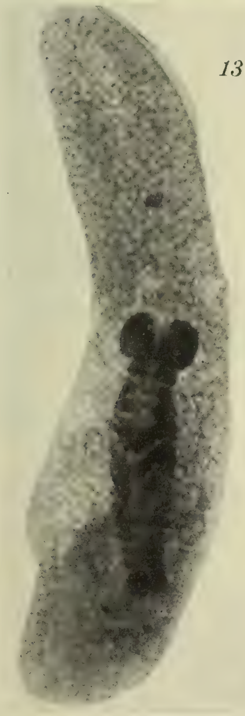

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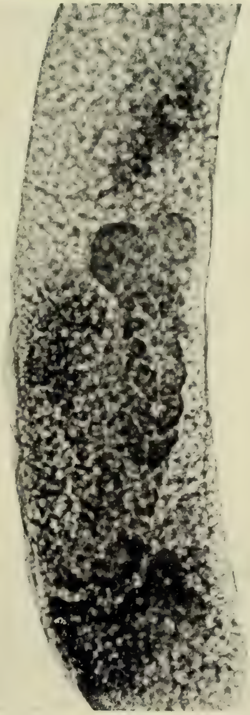

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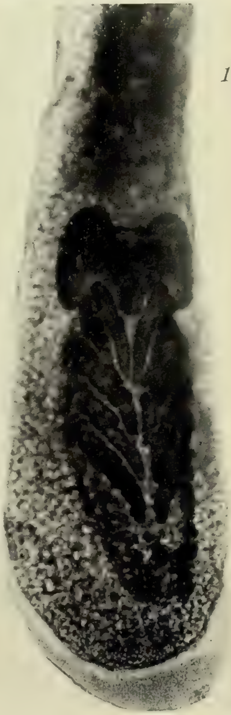


15

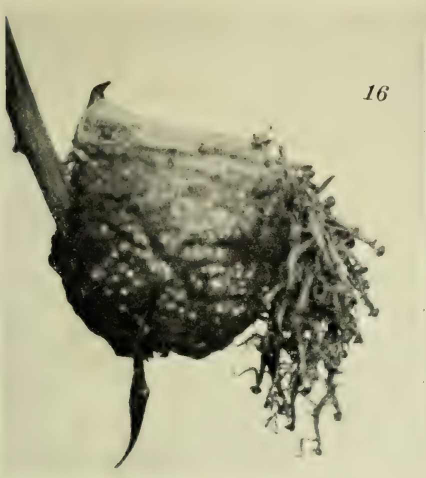
PLATE 3

EXPLANATION OF FIGURES

16 Embryos hatching from an ootheca. At first they hang suspended by the threads attached to the hypodermis but almost at once undergo their first ecdysis which frees them. (Natural size.)

17 First nymphal stage with first ecdysis almost completed. Removal of the epidermis from the metatarsi seems to be most difficult. × 4.

18 The adult female mantid, Paratenodera sinensis. (Natural size.)



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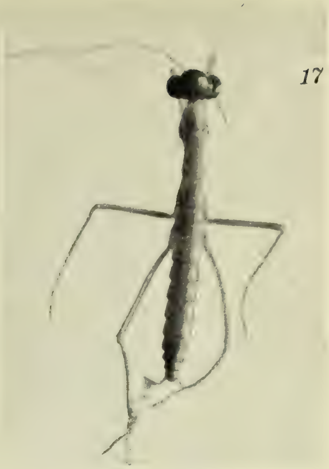

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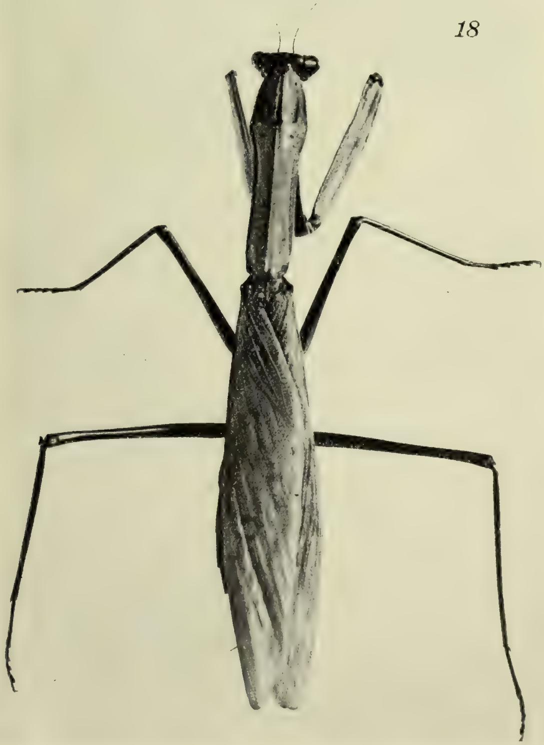

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THE JOURNAL OF MORPHOLOGY
VOLUME 30, NUMBER 1, DECEMBER 20, 1917

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Occasional Papers

OF THE

Boston Society of Natural History.

VII.

FAUNA OF NEW ENGLAND.

14.

LIST OF THE HEMIPTERA-HETEROPTERA.

By HOWARD M. PARSHLEY.

BOSTON:
PRINTED FOR THE SOCIETY FROM THE
GURDON SALTONSTALL FUND.
August, 1917.

Announcement.

FAUNA OF NEW ENGLAND.

The Library and Publishing Committee will issue, as volume seven of the Occasional Papers, a Catalogue of the animals of New England.

Parts will be published at irregular intervals, and though the details of the several lists will vary somewhat in the different groups, each list will include: 1st, the accepted name (scientific and vernacular); 2d, reference to the original description, and to an authentic description and illustration except in case of groups for which recent check-lists have been issued; and 3d, habitat and occurrence.

The Committee considers these lists a necessary preliminary to a series of comprehensive, illustrated monographs, the publication of which the Society has already begun. The Committee also believes that these lists will aid in the accumulation of valuable material for the New England collection. A price list of the parts already published will be found on the back cover page.

Toward the accomplishment of its aims the Committee invites the coöperation of all interested in the Fauna of New England.

Communications concerning specimens should be addressed to the CURATOR of the Society (Chas. W. Johnson), notes and records of occurrence to the EDITOR of the "Fauna of New England."

Boston Society of Natural History,
234 Berkeley St., Boston, Mass.

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INTRODUCTION.[1]

FAUNAL lists based on intensive study of circumscribed areas provide the greater part of the data used in more comprehensive investigations of geographical distribution. Their usefulness in this respect, aside from the important questions of completeness and accuracy, depends largely upon the degree of detail with which the subject matter is presented. A species may, for instance, be found in Maine, New Hampshire, and Massachusetts and yet be restricted in reality to a very special habitat; so that an investigator of the general distribution of this species, finding it recorded perhaps as occurring "throughout New England" would be entirely misled, if as a matter of fact the form in question lived only in northern Maine and on the higher elevations of New Hampshire and western Massachusetts, where distinctly boreal conditions prevail. In preparing this list of the Heteropterous Hemiptera of New England I have therefore thought it worth while to present in considerable detail the available distributional and seasonal data not only for the rarer species but also for those of most frequent occurrence, as it is just these common species that are often of greatest interest, but concerning which it is unusual to find in the literature anything more than very general statements. The position and general character of the localities cited may be ascertained by reference to ordinary and topographical maps of the region, while the seasonal data will obviously be of direct usefulness to those interested in the economic aspect of the subject, hibernation, etc.

Full synonymy and bibliography are to be found in the publications of Banks [1] and Van Duzee [2] and are therefore omitted here as their inclusion would greatly enlarge the paper without materially enhancing its value. In case of certain recently described species, however, the original reference is given. Except for a few points of disagreement, such as the taxonomic standing of the Alydidae, Corizidae, Meziridae (Dysodiidae), and Piesmidae (which I consider entitled to family rank), and certain minor matters, chiefly grammatical, I have adopted the nomenclature and systematic arrangement of Van Duzee's recent check list, which, being based on the latest studies, reflects very well the present condition of the taxonomy of the group.

---

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 133.

Part 2 of a thesis submitted to the Faculty of the School of Applied Biology of Harvard University in partial fulfillment of the requirements for the degree of Doctor of Science.

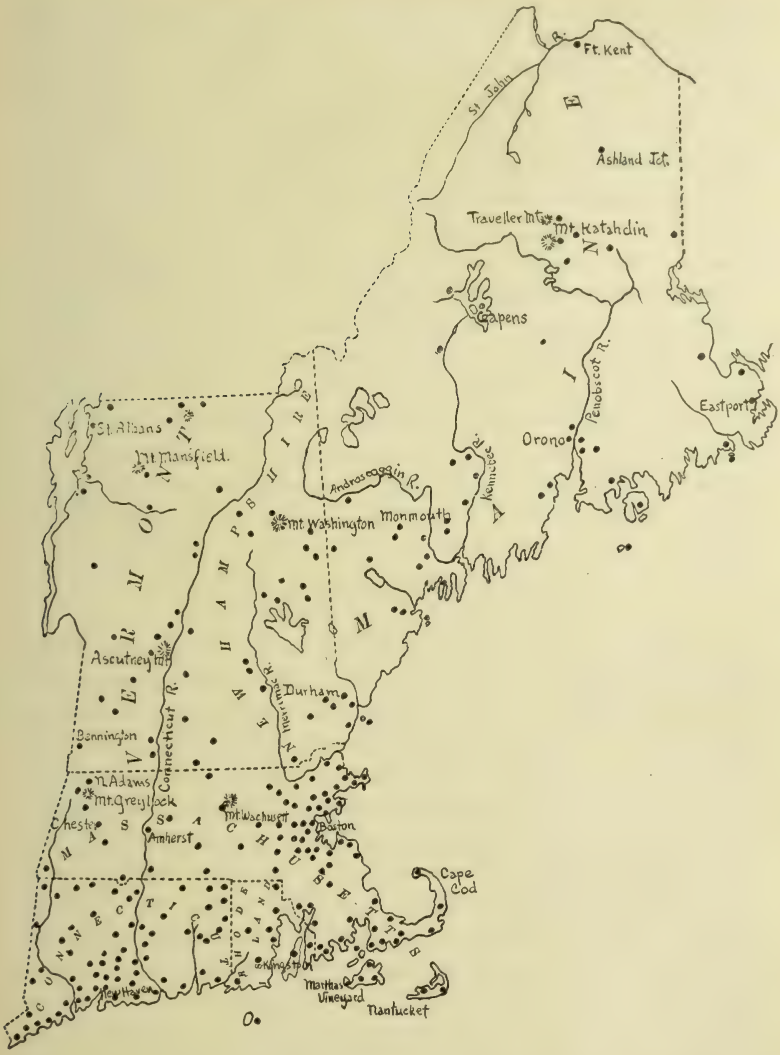
The very large amount of data at hand, from which have been chosen for publication the records showing most clearly and fully the known distribution of the species and their earliest and latest times of appearance in each State, has been gathered for the most part during a first-hand study of the material contained in the various collections of New England, although published records of importance have been included on the authority of others (and so indicated in every case) when I considered them to be trustworthy. Thus I am personally responsible for the determinations, although in this connection I am glad to acknowledge my indebtedness to Messrs. Abbott, Barber, Heidemann, Knight, McAtee, de la Torre Bueno, and Van Duzee, whose ready assistance in points relating to their specialties has done much to increase the accuracy of the list. It is believed that a very large proportion of the species inhabiting New England is recorded in this paper, since the thorough exploration of the region by collectors, as shown on the accompanying map, has provided very extensive material in the group, which has been made available for the purposes of this study through the kindness of those in charge of the following collections wherein the specimens are now preserved: Boston Society of Natural History (C. W. Johnson); Connecticut Agri-

---

[1] Banks, Nathan. Catalogue of the Nearctic Hemiptera-Heteroptera. Philadelphia, 1910, 103 + viii pp.

[2] Van Duzee, E. P. Check List of the Hemiptera. . . . of America, North of Mexico. New York, 1916, xii + 111 pp.

—— —— Catalogue of North American Hemiptera (now in press).



Text-fig. 1.— Map of New England. The dots show where Hemiptera have been collected.

cultural Experiment Station (W. E. Britton); Maine Agricultural Experiment Station (E. M. Patch); Massachusetts Agricultural College (H. T. Fernald); Museum of Comparative Zoölogy (S. Henshaw and N. Banks); New Hampshire Agricultural Experiment Station (W. C. O'Kane); Rhode Island State College (J. Barlow); Wellesley College (A. P. Morse); and many private cabinets the owners of which are mentioned in the appended list of collectors.

It is a great pleasure to take this opportunity of expressing my especial sense of obligation to Charles W. Johnson. His unusual success as a collector, intimate knowledge of our region and its fauna, and stimulating advice have been of the very greatest assistance in the present undertaking; his unfailing enthusiasm and genial nature have made our frequent consultations a constant source of enjoyment,— truly a rare and valued friend!

Analysis of the data presented in the following pages brings out much of general interest, which may now be summarized in part.

Faunal Zones.

The lack of exact knowledge bearing on the distribution of the Hemiptera in British America and many parts of the United States seriously interferes with detailed speculation on the origin and nature of the New England fauna, but the facts at hand seem sufficient to warrant a few observations relative to this subject.

As observed by Scudder in his distributional studies on Lepidoptera,[1] the southern shore of New England as far north as Cape Cod exhibits marked Upper Austral characteristics, a conclusion borne out by the work of many subsequent writers on the fauna and flora of the region. The present investigation furnishes further evidence in support of this view, as I am able to record the discovery within this area of such characteristically southern Hemipterous species as *Solubea pugnax, Corizus hyalinus, Mesomiris curtulus*, and *Garganus fusiformis*. *Macrotracheliella nigra* may be included here as it is very closely related to the only other member of the genus, a form occurring in Mexico and Panama.

---

[1] Scudder, S. H. The Butterflies of the Eastern United States and Canada, Cambridge, 1889, vol. 1, p. 89 *et seq.*

Scudder also pointed out that the northern part of Maine and the higher elevations of the mountains of New England are boreal in character, a statement which has likewise been well supported by later investigations, but here the evidence of the present study is less telling, partly for reasons already mentioned, though chiefly because of the interesting fact that most of the Hemiptera peculiar to these portions of our region are species common to the New and Old Worlds. Whether these forms are truly boreal when subjected to Nearctic conditions (though most of them are not so in Europe); whether they have been for other reasons unable to spread southward; whether they migrated hither from the east or from the west — these are questions which it is impossible to answer now, but which may find explanation when more is known of the distribution of the Hemiptera in Canada. The following are examples of this class, being confined, in New England at least, to northern latitudes or high altitudes: *Sciocoris microphthalmus, Nabis limbatus, N. flavomarginatus, Dictyonota tricornis, Lygus pratensis rubidus, Mecomma ambulans, Callicorixa praeusta.*

The remaining and larger portion of our region belongs to the Transition Zone in which typically northern and typically southern forms find respectively their southern and northern limits. Here each species is a law unto itself, some extending far into the zone, others for but a short distance. The following may be cited as exhibiting this irregular dispersal: from the south, *Piesma cinerea, Leptostyla heidemanni, Hesperotingis antennata, Systelloderes biceps, Phymata erosa, Zelus socius, Rhynocoris ventralis, Gerris canaliculatus;* from the north, *Homaemus aeneifrons, Eurygaster alternata, Corizus crassicornis, Ligyrocoris contractus, Calocoris norvegicus, Poeciloscytus unifasciatus, Limnoporus rufoscutellatus.*

SPECIES COMMON TO NEW ENGLAND AND THE PALAEARCTIC REGION.

More of the species of Hemiptera common to the Nearctic and Palaearctic faunas are to be found in New England, according to present knowledge, than in any other area of similar extent in this country, 36 or 60% of the 61 recorded by Horváth[1] finding place in the subjoined list, besides ten detected since. Horváth gives evidence tending to show that a great majority of these species are of Palaearctic origin, and supposes further that their migration was largely eastward, by way of Alaska. The latter opinion seems hardly in accord with the apparent massing of the species on the eastern side of the continent, referred to above, but at least one of the species listed below, *Callicorixa praeusta,* occurs in both Maine and Alaska, and possibly the range of others may be found likewise to extend westward when our knowledge of the fauna of British America is more nearly complete. The following New England species occur also in the Palaearctic region:

Sciocoris microphthalmus
Zicrona caerulea
Corizus hyalinus
C. crassicornis
Aradus lugubris
Nysius thymi
N. ericae
† *Trapezonotus arenarius*[2]
Sphragisticus nebulosus
† *Dictyonota tricornis*
† *Galeatus peckhami*
† *Leptobyrsa rhododendri*[3]
Reduvius personatus[4]
Nabis limbatus
N. flavomarginatus
N. ferus

Cimex lectularius[4]
† *Xylocoris cursitans*
Miris dolabratus
Stenodema trispinosum
Trigonotylus ruficornis
T. brevipes
† *Pithanus maerkeli*
Stenotus binotatus
Calocoris norvegicus
Poeciloscytus unifasciatus
Capsus ater
Lygus pabulinus
L. apicalis
L. pratensis
L. campestris
L. rubicundus

---

[1] Horváth, G. Les relations entre les faunes hémiptérologiques de l'Europe et de l'Amérique du Nord. Ann. Hist.-Nat. Mus. Nat. Hung. Budapest, 1908, vol. 6, pp. 1–14.

[2] The dagger indicates additions to Horváth's list.

[3] Introduced from the United States into Europe.

[4] Probably imported, but thoroughly acclimated and hence to be considered as members of our fauna. *Nabis brevis* has not established itself and is therefore omitted from this list.

Deraeocoris ruber
Monalocoris filicis
† *Halticus apterus*
Orthotylus flavosparsus
† *Mecomma ambulans*
† *Orthocephalus mutabilis*
Onychumenus decolor
Campylomma verbasci
Limnoporus rufoscutellatus
Saldula xanthochila
S. pallipes
? *S. opacula*
? † *S. saltatoria*
Callicorixa praeusta

HEMIPTERA OF MT. WASHINGTON.

Mt. Washington is our highest elevation and supports a rich and diversified fauna upon its slopes; it has therefore received a great deal of attention from entomological collectors and students of distribution. In the present list, 96 species are recorded from the mountain, the altitude of capture being mentioned in most cases, but it should be remembered in connection with those taken on the boreal summit that most of the species normally confined to lower levels may on occasion be carried by ascending atmospheric currents to altitudes where they are quite unable to maintain a continuous existence. Some of the rarest and most remarkable of the New England Hemiptera have been found on Mt. Washington: — *Sciocoris microphthalmus*, a Palaearctic species of which not more than three or four examples have been taken in North America; *Hesperophylum heidemanni*, the only Nearctic representative of the peculiar family Termatophylidae; *Zicrona caerulea*, a cosmopolitan species of very rare occurrence in this part of the world; and *Galeatus peckhami*, reported from Japan and from a few widely separated points in North America.

NUMERICAL SUMMARY.

Nearly 1500 species of Hemiptera-Heteroptera are now known to inhabit America north of Mexico, of which 419 are here listed as occurring in New England. Of the 37 North American families all but 5, the Pyrrhocoridae, Isometopidae, Dipsocoridae, Schizopteridae, and Gelastocoridae, occur within our limits, and it is very probable that representatives of at least the two first mentioned will ultimately be found here. The following table shows the numerical strength of the New England families:

Family	Genera	Species	Family	Genera	Species
Scutelleridae	2	2	Mesoveliidae	1	1
Cydnidae	5	10	Nabidae	3	12
Pentatomidae	29	47	Cimicidae	2	3
Coreidae	5	7	Anthocoridae	4	4
Alydidae	3	5	Termatophylidae	1	1
Corizidae	2	6	Miridae	62	139
Aradidae	1	12	Hydrometridae	1	1
Meziridae	2	4	Gerridae	4	9
Neididae	2	2	Veliidae	2	5
Lygaeidae	38	52	Saldidae	4	16
Piesmidae	1	1	Notonectidae	3	8
Tingidae	11	21	Naucoridae	1	1
Enicocephalidae	1	1	Nepidae	2	4
Phymatidae	1	2	Belostomatidae	3	5
Reduviidae	13	20	Ochteridae	1	1
Hebridae	1	1	Corixidae	4	16
			Totals	215	419

List of Collectors.

I am greatly indebted to the collectors mentioned in the following list, since the paper is based entirely on the results of their work. To them, I am sure, the arid waste of dates will not be without oases, and the mention of favored collecting grounds will recall most pleasant memories.

Abbott, J. F.
Adkins, W. S.
Alexander, C. P.
Allen, G. M.
Allen, J. A.
Bangs, O. (*O. Bangs*).
Barber, H. G.
Barlow, J.
Barrows, W. M.
Blanchard, F.

Bourne, A. I.
Bridwell, J. C.
Britton, W. E.
Brooks, W. S.
Brues, C. T.
Bryant, O. (*O. B.*).
Bullard, C.
Burgess, E.
Buttrick, P. L.
Caffrey, D. J.
Carnochan, F. G.
Champlain, A. B.
Clinch, W. T.
Cole, W. H.
Crampton, G. C.
Cushman, J. A.
Davis, C. A.
Davis, I. W.
Davis, W. T.
Davison, C. H.
Dickerman, L. L.
Dickerson, E. L.
Dodge, F. W.
Dohanian, S. M.
Dow, R. P.
Easton, N. S.
Eddy, F. A.
Edwards, A. M.
Ely, C. R.
Emerton, J. H.
Engelhardt, G. P.
Fernald, H. T.
Fiske, W. F.
Foote, H. W.
Frost, C. A.
Greene, E.
Harris, T. W.
Henshaw, S.
Hill, W. B.
Hochstein, R.
Hollister, G. H.
Holt, H.
Hyslop, J. A.
Johnson, C. W.
Johnson, H. L.
Jump, E. R.
Kirk, H. B.
Kirkland, A. H.
Knab, E.
Lewis, J. K.
Lowry, Q. S.
Mann, W. M.
Marchand, W.
Mason, S. L.
McAtee, W. L.
Merrill, E. D.
Miller, C. S.
Minot, C. S.
Montgomery, T. H.
Moore, E. J. S.
Morse, A. P.
Nelson, S. A.
Olsen, C. E.
Osborn, H.
Osterberg, C.
Packard, A. S.
Parshley, H. M.
Parshley, N. F.
Patch, E. M.
Pepper, G. W.
Reiff, W.
Renshaw, A. H.
Ripley, L. B.
Sanborn, F. G.
Sarsfield, W.
Sharp, O.
Shaw, S. A.
Sherriff, F. A.
Slosson, A. T.
Small, C. L.
Smith, H. E.
Smith, S. J.
Sprague, F. H.
Sprague, P. S.
Stebbins, S.
Stoddard, E. M.

Stover, O. O.
Tenney, A. J.
Thompson, E. W.
Torre Bueno, J. R. de la
Uhler, P. R.
Vaillant, G. H.
Van Duzee, E. P.
Viereck, H. L.
Walden, B. H.
Webber, R. T.
Weed, C. M.
Wheatland, R. H.
Wheeler, W. M.
Whiting, P. W.
Whitney, C. P.
Whittlesey, E. B.
Wilcox, A. M.
Williams, F. X.
Willis, W. E.
Winkley, H. W.
Wood, H.
Woodruff, L. B.
Woods, W. C.
Zappe, M. P.

HEMIPTERA–HETEROPTERA.

SCUTELLERIDAE.

TETYRINAE.

Homaemus aeneifrons (Say).

ME.— Ft. Kent, 19 Aug. '10 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Machias, 22 July '09 (*C. W. J.*); Orono, 12 Sept. '13 (*H. M. P.*); Pemaquid Pt., Aug. '06 (*H. W. F.*); Pownal, 26 Aug. '00 (*O. O. S.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Alstead, 3 Aug. '04 (*A. P. M.*); Crawfords, 3 Oct. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Mt. Washington, base, 19 Sept. '09 (*C. W. J.*); summit (*fide Slosson*).

MASS.— Amherst, 9 Aug. '04; Forest Hills (*A. M. W.*); Ipswich, 1 Sept. '13 (*E. R. J.*); Peru, 28 Aug. '04 (*J. B.*); Sherborn, 8 July '92 (*A. P. M.*); Tyngsboro, 7 Sept. '02 (*F. B.*).

CONN.— Colebrook, 1 Sept. '11 (*W. M. W.*); Litchfield, 16 Sept. '08 (*L. B. W.*); Scotland, 10 Aug. '05 (*B. H. W.*); Thompson, 11 July '05 (*H. L. V.*).

ODONTOTARSINAE.

Eurygaster alternata (Say).

ME.— Eastport, 15 July '09 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Liberty, 17 July '12 (*J. A. C.*); Orono, 8 Aug. '13; Pownal (*O. O. S.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, base, 6 July '14 (*C. A. F.*); summit (*fide Slosson*); Surrey, 30 Aug. '02.

VT.— St. Johnsbury, 23 July '91 (*A. P. M.*).

MASS.— Amherst, 11 July '94; Beach Bluff, 28 June '15 (*H. M. P.*); Cohasset, 6 Sept. '07 (*O. B.*); Forest Hills, 30 May '72 (*S. H.*); Nantucket, 19 Aug. '09 (*J. A. C.*); Springfield, 13 July

'05 (*C. W. J.*); West Chop, 22 July '93 (*A. P. M.*); Williamsburg, 9 Aug. '10 (*C. W. J.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, 1 July '05 (*J. A. C.*).

R. I.— Cumberland, 3 July '10 (*J. B.*); Kingston, 5 May '08 (*J. B.*); 29 Aug. '91 (*A. P. M.*).

Conn.— Litchfield, 31 May '13 (*L. B. W.*); New Haven, 8 June '04 (*W. E. B.*); Scotland, 25 July '04 (*B. H. W.*); S. Meriden, 19 June '14 (*H. L. J.*); Thompson, 3 Aug. '92 (*A. P. M.*).

CYDNIDAE.

Thyreocorinae.

Thyreocoris ater (Amyot and Serville).

Me.— Orono, 15 Sept. '13 (*H. M. P.*); Paris, 9 July '15 (*C. A. F.*); Pownal (*O. O. S.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Fitzwilliam, July '07 (*J. H. E.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Amherst, 10 May '15; Beach Bluff, 31 Aug. '14 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Lynn, 17 May '14 (*F. W. D.*); Nantucket, 19 Aug. '09 (*J. A. C.*); Sherborn, 20 Oct. '16 (*C. A. F.*); Tyngsboro, 26 Mar. '06 (*F. B.*).

R. I.— Kingston, 15 July '05 (*J. B.*); Warwick, 10 Sept. '97.

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Thyreocoris nitiduloides (Wolff).

Me.— Deering, 21 Aug. '92 (*A. P. M.*); Orono, 15 Sept. '13 (*H. M. P.*); Paris, 10 July '15 (*C. A. F.*).

Mass.— Amherst; Forest Hills, 16 Sept. '14 (*H. M. P.*); Framingham, 2 May '15 (*C. A. F.*); Southboro, 24 May '14 (*C. A. F.*); Tyngsboro (*F. B.*); Wellesley, 4 Nov. '98 (*A. P. M.*); Winchendon, 5 July '92 (*A. P. M.*).

R. I.— Kingston, 14 Sept. '07 (*J. B.*).

Conn.— Litchfield, 7 Sept. '01 (*L. B. W.*); Milldale, 21 May '06 (*B. H. W.*); Salem, 10 July '14 (*H. W. F.*); S. Meriden, 21 May '15 (*H. L. J.*); Westville, 9 Aug. '06 (*B. H. W.*).

Thyreocoris lateralis (Fabricius).

Mass.— Woods Hole, 23 Aug. '14 (*W. M. M.*).

R. I.— June.

Conn.— Chapinville, 26 May '04 (*W. E. B.*); Winnipauk, 16 June '09 (*C. W. J.*).

Thyreocoris pulicarius (Germar).

Me.—Orono, 31 May '14 (*H. M. P.*); Paris, 10 July '15 (*C. A. F.*).

Vt.— Winooski, Aug. '01 (*C. A. D.*).

Mass.— Amherst, 31 July '97; Blue Hills, 22 May '15 (*H. M. P.*); Fall River, 22 July '05 (*J. A. C.*); Framingham, 2 May '15 (*C. A. F.*); Lynn, 18 Aug. '15 (*H. M. P.*); Springfield, 13 July '05 (*C. W. J.*); Tyngsboro (*F. B.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Kingston, 28 May '05 (*J. B.*); Providence, 16 Aug. (*C. A. D.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Litchfield, 3 Aug. '01 (*L. B. W.*); New Haven, 17 May '06 (*B. H. W.*); Stafford, 24 Aug. '05 (*W. E. B.*).

CYDNINAE.

Tribe CYDNINI.

Pangaeus bilineatus (Say).

Mass.— (*fide Uhler*).

Conn.— (*fide Uhler*).

Geotomus robustus (Uhler).

Mass.— (*fide Uhler*).

Amnestus spinifrons (Say).

Mass.— Amherst, 13 June '97; Forest Hills, 17 April '15 (*F. G. C.*); Framingham, 21 Oct. '07 (*C. A. F.*); Milton, 28 Mar. '28 (*Harris Coll.*); Tyngsboro, 21 Apr. '95 (*F. B.*); W. Springfield, 21 Oct. '15 (*H. E. S.*).

R. I.— Kingston, 26 Feb. '07, in greenhouse (*J. B.*).

Conn.— Orange, 21 May '11 (*B. H. W.*); Southington, 27 April '10 (*W. E. B.*); S. Meriden, 1 May '14 (*H. L. J.*); West Haven, 11 May '05 (*B. H. W.*); Yalesville, 26 May '08 (*B. H. W.*).

Amnestus pusillus Uhler.

Me.— Paris, 10 July '15 (*C. A. F.*).

Mass.— Tyngsboro (*F. B.*).

Amnestus pallidus Zimmer.

Mass.— Cambridge; Saugus, 21 June '14 (*F. W. D.*); Wellesley, 27 May '91 (*A. P. M.*).

Conn.— New Haven, 15 May '05 (*B. H. W.*).

Tribe Sehirini.

Sehirus cinctus (Palisot de Beauvois).

Me.— Capens, 11 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono, 7 April '12 (*H. M. P.*); Paris, 4 July '15 (*C. A. F.*); Sherman, 28 Aug. '03 (*O. O. S.*); The Forks (*O. O. S.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Glen House, 3 July '14 (*C. W. J.*); Mt. Washington, base, 19 Sept. '09 (*C. A. F.*); summit (*fide Slosson*); Halfway House, 16 July '15 (*C. W. J.*); Randolph, Oct. '98 (*F. B.*).

Vt.— Jay, 17 July '91 (*A. P. M.*); Weston, July '01.

Mass.— Amherst; Boston, 2 July '03 (*H. M. P.*); Milton, 22 April '29 (*Harris Coll.*); Peru, June '04 (*J. B.*).

R. I.— Providence, 1 July (*C. A. D.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); New Haven, 9 July '11 (*B. H. W.*).

PENTATOMIDAE.

Graphosomatinae.

Tribe Podopini.

Podops cinctipes (Say).

N. H.— Hampton, 13 Feb. '02 (*S. A. S.*).

Mass.— Beach Bluff, 21 June '15 (*H. M. P.*); Boston, 29 April '03 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Framingham, 16 May '09 (*C. A. F.*); Tyngsboro, 2 Oct. '02 (*F. B.*); Woods Hole, 1 July '14 (*W. S. A.*).

Conn.— New Haven, 20 Aug. '09 (*B. H. W.*); S. Meriden, 7 June '14 (*H. L. J.*).

Podops parvula Van Duzee.
Mass.— Revere, 18 Sept. '97; Woods Hole.

Pentatominae.

Tribe Sciocorini.

Sciocoris microphthalmus Flor.
Me.— Southwest Harbor, 1 (?) Aug. '87 (*H. T. F.*).
N. H.— Mt. Washington, summit (*fide Slosson, Van Duzee*).

Tribe Halyini.

Brochymena arborea (Say).
N. H.— Mt. Washington, summit (*fide Slosson*).

Mass.— Amherst; Ashland, 4 June '11 (*C. A. F.*); Cohasset, 1 Sept. '05 (*O. B.*); Concord, 6 Aug. '14 (*W. R.*); Hopkinton, 21 Sept. '12 (*W. R.*); Hyde Park, 27 April '12 (*W. R.*); Sutton (*Harris Coll.*); Tyngsboro, Jan. '98 (*F. B.*).

Conn.— Lyme, 14 May '11 (*A. B. C.*); New Canaan, 22 Sept. '10 (*W. E. B.*); New Haven, 5 Sept. '11 (*D. J. C.*); North Branford, 8 June '12 (*B. H. W.*); Stonington, May '14 (*I. W. D.*).

Brochymena quadripustulata (Fabricius).
N. H.— Durham (*C. M. W. & W. F. F.*).

Mass.— Amherst; Forest Hills, 8 Oct. '16 (*A. M. W.*); Lynn, 17 May '14 (*F. W. D.*); Sherborn, Sept. (*C. A. F.*); Tyngsboro (*F. B.*).

Conn.— Farmington, 11 June '14 (*W. M.*); New Canaan, 9 Oct. '02 (*B. H. W.*); New Haven, 6 Sept. '02 (*B. H. W.*); Portland, 15 May '14 (*B. H. W.*); S. Glastonbury, 18 Oct. '04 (*W. E. B.*).

Brochymena carolinensis (Westwood).
Mass.— Framingham, 5 June '10 (*C. A. F.*); Tyngsboro, May '96 (*F. B.*); Waltham (*C. B.*).

Conn.— Rainbow, 7 May '14 (*M. P. Z.*).

Tribe PENTATOMINI.

Peribalus limbolarius Stål.

MASS.— Amherst, 10 July '95; Beach Bluff, 26 July '14 (*H. M. P.*); Boston, 28 Aug. '76 (*S. H.*); Forest Hills, 21 May '16 (*A. M. W.*); Nantucket, Sept. '92 (*S. H.*); Norwood, 18 April '09 (*W. R.*).

CONN.— Hamden, 24 July '10 (*B. H. W.*); Manchester, 30 Aug. '12 (*D. J. C.*); New Haven, 24 June '02 (*E. J. S. M.*); Rainbow, 24 May '15 (*M. P. Z.*); S. Meriden, 22 April '15 (*H. L. J.*).

Trichopepla semivittata (Say).

MASS.— Amherst, 2 Aug. '97; Chilmark, 7 Aug. '11 (*J. A. C.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 24 May '16 (*A. M. W.*); Nantucket, 4 July '04 (*J. A. C.*); Sharon, 25 Aug. '13; West Chop, 15 July '93 (*A. P. M.*); Woods Hole, 11 Aug. '05 (*J. A. C.*).

R. I.— Kingston, 26 Aug. '07 (*J. B.*); Providence, 13 Sept. (*C. A. D.*).

CONN.— New Haven, 24 June '02 (*E. J. S. M.*), 12 Sept. '04 (*B. H. W.*); S. Meriden, 28 May '15 (*H. L. J.*).

Rhytidolomia saucia (Say).

MASS.— Cohasset, 21 Sept. '14 (*H. M. P.*); Greenbush, 11 May '13 (*W. S. B.*); Ipswich, 31 Aug. '13 (*E. R. J.*); Milton, 1 Sept. '27 (*Harris Coll.*); Provincetown; Woods Hole, July (*T. H. M.*).

CONN.— East Haven, 2 May '12 (*B. H. W.*); Greenwich, 21 Aug. '94 (*A. P. M.*); Lyme, 3 July '10 (*A. B. C.*); New Haven, 20 July '05 (*B. H. W.*).

Rhytidolomia senilis (Say).

MASS.— Cambridge, 20 Sept.; Cohasset, 5 Sept. '05 (*O. B.*); Dorchester, 23 Aug. '01 (*A. P. M.*); Faneuil, 12 Aug. '04 (*A. P. M.*); Forest Hills, 20 Mar. '15 (*C. T. B.*); Milton, 10 May '35 (*Harris Coll.*); Revere, 23 Sept. '96; Wollaston, 17 Nov. '95 (*F. H. S.*).

R. I.— Providence, July (*C. A. D.*).

CONN.— Branford, 20 Aug. '05 (*H. W. W.*); East Haven, 2 May '12 (*B. H. W.*); New Haven, 7 May '11 (*A. B. C.*).

Chlorochroa uhleri Stål (= *C. persimilis* Horváth).

Me.— Houlton, 24 Aug. '13; Orono, 26 Sept. '12 (*H. M. P.*); Pownal, 26 Aug. '00 (*O. O. S.*); Southwest Harbor (*H. T. F.*).

N. H.— Contoocook, 7 Aug. '06; Durham (*C. M. W. & W. F. F.*); Pelham, 5 Sept. '05; Three Mile Id., 3 June '09 (*F. B.*); Webster (*W. F. F.*).

Vt.— Middlebury, July '12.

Mass.— Amherst, 9 Sept. '05; Framingham, 31 May '09 (*C. A. F.*); Lynn, 17 May '14 (*F. W. D.*); Nantucket, 17 Sept. '92 (*S. H.*); Provincetown, 8 Sept. '90 (*A. P. M.*); Tyngsboro, 13 Sept. '91 (*F. B.*); West Chop, 24 July '93 (*A. P. M.*).

Conn.— Manchester, 4 Sept. '13 (*B. H. W.*); S. Meriden, 1 June '15 (*H. L. J.*).

Mormidea lugens (Fabricius).

Me.— Dexter, 15 June '00 (*O. O. S.*); Liberty, 13 Sept. '13 (*J. A. C.*); Orono, 25 July '05; Wales, 18 June (*C. A. F.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Burlington, 22 June '06 (*C. W. J.*); St. Albans, 29 June '13 (*C. W. J.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Hanover (*C. M. W.*); Durham, 20 June '07; Waterville (*W. F. F.*); Webster (*W. F. F.*); Wonalancet, 13 Sept. '12 (*J. A. C.*).

Mass.— Amherst, 24 May '04; Beach Bluff, 5 July '14; (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Framingham, 21 Jan. '06 (*C. A. F.*); Martha's Vineyard, 11 Sept. '15 (*W. S. A.*); Nantucket, 6 Aug. '13 (*J. A. C.*); Provincetown, 1 Sept. '14; Woods Hole, 1 July '05.

R. I.— Kingston, 16 June '07 (*J. B.*); Providence, 6 June (*C. A. D.*); Tiverton, 31 July '13 (*N. S. E.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Darien, 27 May '13 (*C. W. J.*); New Haven, 20 June '02 (*E. J. S. M.*); Portland, 5 June '14 (*B. H. W.*); Scotland, 30 July '04 (*B. H. W.*); Stonington, 1 July '14 (*I. W. D.*); Torrington, 7 July '05 (*W. E. B.*).

Solubea pugnax (Fabricius).

Conn.— Stamford, 13 Aug. '91 (*A. P. M.*).

Euschistus euschistoides (Vollenhoven) (= *E. fissilis* Uhler).

Me.— Liberty, 13 Sept. '13 (*J. A. C.*); Monmouth, 15 July '14 (*C. A. F.*); Orono, 20 June '07.

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Durham, 9 Aug. '07; Hanover (*C. M. W.*); Jackson, 22 Sept. (*C. W. J.*); Webster (*W. F. F.*); Wonalancet, 13 Sept. '12 (*J. A. C.*).

Mass.— Amherst, 17 June '05; Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 25 April '16, 30 Sept. '15 (*H. M. P.*); Martha's Vineyard, Gay Head, 11 Sept. '15 (*W. S. A.*); Nantucket, 5 Sept. '07 (*H. T. F.*); Provincetown, 28 June '91 (*A. P. M.*); Rutland, 20 Sept. '16 (*C. W. J.*); Woods Hole, 11 Aug. '05 (*J. A. C.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*).

Conn.— Colebrook, 20 July '05 (*W. E. B.*); Darien, 12 June '15 (*C. W. J.*); Farmington, 6 Sept. '14 (*W. M.*); Greenwich, 9 July '07 (*J. A. C.*); Litchfield, 31 May '13 (*L. B. W.*); New Haven, 12 July '05 (*B. H. W.*); Scotland, 10 Aug. '05 (*B. H. W.*); S. Meriden, 17 July '14 (*H. L. J.*); Stonington, 22 July '13 (*L. B. R.*).

Euschistus politus Uhler.

N. H.— Mt. Washington, summit (*fide Slosson*).

Mass.— Blue Hills, 14 Aug. '78 (*S. H.*); Framingham, 27 May '16 (*C. A. F.*); Lynn, 2 Sept. '15 (*H. M. P.*); Provincetown, 8 Sept. '07 (*A. P. M.*); Saugus, 7 Sept. '14 (*H. M. P.*); Tyngsboro (*F. B.*); Waltham, 30 May '97 (*C. B.*).

R. I.— Kingston, Sept. '06 (*J. B.*).

Euschistus tristigmus (Say).

Me.— Capens, 12 July '07 (*C. W. J.*); Durham, 21 July '97 (*O. O. S.*); Ft. Kent, 14 June '13 (*C. W. J.*); Machias, 26 July '09 (*C. A. F.*); Monmouth, 15 July '14 (*C. A. F.*); Orono, 17 Sept. '13 (*H. M. P.*); Traveller Mt., 27 July '10 (*J. A. C.*).

N. H.— Bretton Woods, 25 June '13 (*C. W. J.*); Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Hanover (*C. M. W.*); Pelham, 5 April '05; Webster (*W. F. F.*).

Vt.— Dummerston, 14 July '08 (*C. W. J.*); S. Hero, Grand Isle, 9 July '04 (*A. P. M.*); Norwich, 8 July '08 (*C. W. J.*); Winooski, 22 Aug. '01 (*C. A. D.*).

Mass.— Amherst, 27 May '11; Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Chester, 27 May '12 (*C. W. J.*); Nantucket, 3 July '06 (*J. A. C.*); N. Adams, 18 June '06 (*C. W. J.*); Peru, 26 Aug. '04 (*J. B.*); Provincetown, 8 Sept. '07 (*A. P. M.*); Westfield, 22 June '13 (*P. W. W.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, 13 May '06 (*J. B.*).

Conn.— Colebrook (*W. M. W.*); Danbury, 15 June '09 (*C. W. J.*); E. Hartford, 13 Aug. '06 (*B. H. W.*); New Canaan, 21 Sept. '05 (*W. E. B.*); New Haven, 27 Aug. '14 (*W. E. B.*); Portland, 29 May '14 (*B. H. W.*); Torrington, 7 July '05 (*W. E. B.*).

Euschistus variolarius (Palisot de Beauvois).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, 1 July '74 (*J. H. E.*); Pelham, 29 Aug. '05.

Mass.— Amherst, 22 Oct. '94; Blue Hills, 22 May '15 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '15 (*H. M. P.*); Cohasset, 13 Sept. (*O. B.*); Mt. Greylock, 3500 ft., 17 Aug. '94 (*A. P. M.*); Peru, 28 July '04 (*J. B.*); W. Springfield, 2 Oct. '15 (*H. E. S.*); Winchendon, 2 July '92 (*A. P. M.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

Conn.— Greenwich, 4 Nov. '04 (*W. E. B.*); Hartford, 19 Oct. '04 (*W. E. B.*); Mystic, 25 July '15 (*M. P. Z.*); New Haven, 13 Aug. '03 (*B. H. W.*); Scotland, 25 July '04 (*B. H. W.*); Torrington (*R. H.*).

Euschistus ictericus (Linné).

Vt.— Winooski, 14 Aug. '01 (*C. A. D.*).

Mass.— Beach Bluff, 15 Aug. '14 (*H. M. P.*); Boston, Chestnut Hill, 15 Sept. '14 (*H. M. P.*); Nantucket, 20 Sept. '15 (*W. S. A.*); Provincetown, 8 Sept. '07 (*A. P. M.*); Tyngsboro, 22 Oct. '93 (*F. B.*); Wellesley, 13 June '91 (*A. P. M.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*); Buttonwoods, 18 June '12 (*C. W. J.*).

Conn.— Branford, 16 Sept. '04 (*H. W. W.*); Hamden, 24 July '10 (*B. H. W.*); New Haven, 27 July '04 (*P. L. B.*).

Coenus delius (Say).

Me.— Bar Harbor; Orono, 5 May '12 (*H. M. P.*); Norway (*S. J. S.*); Pownal, 26 Aug. '00 (*O. O. S.*); Westbrook, 25 Sept. '00 (*O. O. S.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover, 30 June '01; Jaffrey, 15 Sept. '96 (*S. H.*).

Mass.— Amherst, 24 May; Arlington, 26 April '77 (*S. H.*); Beach Bluff, 25 June '15 (*H. M. P.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Framingham, 27 June '14 (*C. A. F.*); Nantucket, 4 July '05 (*J. A. C.*); Siasconset, 12 Sept. '15 (*W. S. A.*); Southboro (*O. S.*); Woods Hole, July (*T. H. M.*); Springfield; Tyngsboro (*F. B.*).

R. I.— Kingston, 29 July '91 (*A. P. M.*).

Conn.— Farmington, 10 Aug. '14 (*W. M.*); New Haven, 18 March '91 (*A. B. C.*); Scotland, 25 July '04 (*B. H. W.*); Stamford, 16 Aug. '12 (*W. E. B.*); Thompson, 10 May '10 (*B. H. W.*); Yalesville, 6 Oct. '10 (*D. J. C.*).

Hymenarcys nervosa (Say).

Mass.— Milton, 15 May '26 (*Harris Coll.*); Orleans, 13 May '91 (*F. B.*); Taunton (*G. W. P.*).

R. I.— Kingston, 21 Sept. '05 (*J. B.*).

Neottiglossa undata (Say).

Me.— Bar Harbor, 31 Aug. '13; Bowlin Pond, 31 July '10 (*J. A. C.*); Liberty, 17 July '12 (*J. A. C.*); Mistake Id., 9 Aug. '07 (*J. A. C.*); Orono, 19 May '14; Pownal, 26 Aug. '00 (*O. O. S.*); The Forks, 16 June '00 (*O. O. S.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*).

Mass.— Amherst, 23 June '95; Beach Bluff, 21 June '14 (*H. M. P.*); Framingham, 18 April '14 (*C. A. F.*); Peru, 29 Aug. '04 (*J. B.*); Provincetown, 29 June '91 (*A. P. M.*); Tyngsboro (*F. B.*).

Conn.— Middlebury, 2 June '16 (*M. P. Z.*); North Haven, 3 Aug. '05 (*H. L. V.*).

Cosmopepla bimaculata (Thomas) (= *C. carnifex* Fabricius, Auctt.).

Me.— Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W..J.*); Ft. Fairfield; Monmouth, 15 July '14 (*C. A. F.*); Orono, 13 Aug. '07; Paris, 10 July '14 (*C. A. F.*); Pemaquid Pt., Aug. '06 (*H. W. F.*); Pownal, '94 (*O. O. S.*); Sherman, 28 Aug. '03 (*O. O. S.*).

N. H.— Bretton Woods, 27 June '13 (*C. W. J.*); Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Glen House, 15 July '15 (*C. W. J.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*).

Vt.— Bennington, 18 June '15 (*C. W. J.*); Jay, 15 July '91 (*A. P. M.*); St. Albans, 29 June '13 (*C. W. J.*); Winooski, 21 Aug. '01 (*C. A. D.*).

Mass.— Amherst, 10 June '11; Beach Bluff, 27 July '14 (*H. M. P.*); Chester, 22 May '12 (*C. W. J.*); Dracut, 18 June '91 (*F. B.*); Forest Hills, 4 Oct. '15 (*H. M. P.*); Mt. Tom, 14 July '05 (*C. W. J.*); N. Adams, 20 June '06 (*C. W. J.*); Sherborn, 19 June '15 (*C. A. F.*).

Conn.— Canaan, 19 Aug. '94 (*A. P. M.*); Danbury, 15 June '09 (*C. W. J.*); Meriden, 3 June '10 (*W. E. B.*); Norfolk, 13 July '15 (*M. P. Z.*); Thompson, 11 July '05 (*H. L. V.*).

Menecles insertus (Say).

Mass.— Amherst, 1 June; Blue Hills, 22 May '15 (*S. M. D.*); Boston, City Point, 8 May '14 (*W. M.*); Cambridge, 21 Feb. '74; Concord, 26 April '13 (*W. R.*); Forest Hills, 8 Sept. '15 (*A. M. W.*); Medford, 30 Mar. '02 (*C. A. F.*); Tyngsboro, 29 July '01 (*F. B.*); Wellesley, 23 June '92 (*A. P. M.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Warwick, 1 July.

Conn.— New London, 2 May '13 (*D. J. C.*); Stonington, 16 June '14 (*I. W. D.*); Wallingford, 20 July '10 (*D. J. C.*).

Thyanta custator (Fabricius).

Mass.— Sherborn, 15 June '92 (*A. P. M.*); Taunton (*G. W. P.*).

Thyanta calceata (Say) Barber.

MASS.— Cambridge (*Harris Coll.*).

CONN.— New Canaan, 2 Oct. '07 (*B. H. W.*).

Murgantia histrionica (Hahn).

MASS.— Boston, 8 April '16, on vegetables brought from the South (*C. W. J.*).

CONN.— Meriden, 7 April '10 (*H. L. J.*). This record probably, and the preceding certainly, are due to accidental introduction of individual specimens, though the species is more or less firmly established on Long Island and in New Jersey.

Acrosternum pennsylvanicum (De Geer).

MASS.— Cambridge (*Harris Coll.*); Waltham, 30 May '97 (*C. B.*).

CONN.— Stonington, 30 June '14 (*I. W. D.*).

Acrosternum hilare (Say).

VT.— Winooski, 22 Aug. '01, nymph (*C. A. D.*).

MASS.— Amherst, 12 Sept. '02; Blue Hills, 22 May '15 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Framingham, 12 Sept. '09 (*C. A. F.*).

R. I.— Kingston, 12 Nov. '09 (*J. B.*); Providence, 16 Sept. (*C. A. D.*).

CONN.— Farmington, 3 Sept. '14 (*W. M.*); Lyme, 4 July '11 (*H. B. K. & A. B. C.*); New Canaan, 15 Sept. '05 (*B. H. W.*); New Haven, 2 June '05 (*B. H. W.*); Poquonock, 27 June '05 (*H. L. V.*); S. Meriden, 5 Sept. '14 (*H. L. J.*); Westville, 2 May '15 (*W. E. B.*).

Banasa dimidiata (Say).

ME.— Houlton (*F. A. E.*); Orono, 1 July '13; Sherman; S. Orrington, 28 Sept. '13 (*H. M. P.*); Southwest Harbor, 28 June '10 (*H. T. F.*).

N. H.— Durham, 20 June '07; Mt. Washington, base, 7 July '15 (*C. W. J.*); summit (*fide Slosson*); Pelham, 29 Aug. '05.

MASS.— Amherst, 26 June '95; Blue Hills, 30 May (*C. W. J.*); Boston, 19 Sept. '15 (*H. M. P.*); Chester, 5 Aug. '14 (*C. W. J.*);

Cohasset, Sept. '07 (*O. B.*); Forest Hills, 7 April '16 (*A. M. W.*); Mt. Wachusett, 30 May '14 (*C. W. J.*); Saugus, 21 June '14 (*F. W. D.*); Sherborn, 6 Sept. '14 (*C. A. F.*); Tyngsboro, 19 Nov. '93 (*F. B.*).

R. I.— Kingston, 23 June (*J. B.*).

Conn.— Farmington, 14 June '14 (*W. M.*); Hartford, 19 Oct. '06 (*W. E. B.*); Portland, 15 May '14 (*B. H. W.*); Stonington, 13 June '14 (*I. W. D.*); Union, 26 May '16 (*M. P. Z.*); Wallingford, 28 June '11 (*J. K. L.*).

Banasa calva (Say).

Conn.— Hartford, 1 Nov. '16 (*W. E. B.*); Yalesville, 19 Oct. '03 (*H. L. V.*).

Banasa sordida (Uhler).

Mass.— Cambridge; Milton, 30 Aug. '28 (*Harris Coll.*).

Dendrocoris humeralis (Uhler).

N. H.— Pelham (*F. B.*).

Mass.— Amherst; Andover; Beach Bluff, 18 July '15 (*H. M. P.*); Blue Hills, 17 June '03 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Fall River, 13 May '08 (*N. S. E.*); Forest Hills, 16 April '16 (*F. G. C.*), 20 Oct. '14 (*H. M. P.*); Franklin, 10 July '15 (*C. T. B.*); Saugus, 5 Sept. '14 (*H. M. P.*); Tyngsboro, 22 Oct. '93 (*F. B.*).

Conn.— Killingly, 11 June '15 (*W. E. B.*); Meriden, 10 May '10 (*A. B. C.*); Portland, 22 May '14, 12 Aug. '13 (*B. H. W.*); Stonington, 6 July '14 (*I. W. D.*).

Acanthosomatinae.

Meadorus lateralis (Say).

Me.— Eustis; Kineo, 3 Sept. '07 (*J. A. C.*); Mercer, 3 Aug. '08; Mt. Katahdin, 650 ft., 5000 ft., 21 Aug. '13 (*C. P. A.*); Northeast Harbor, 23 Aug. '09 (*C. S. M.*).

N. H.— Glen House, 3 July '14 (*C. W. J.*); Mt. Lafayette, summit, 22 Sept. '95 (*F. B.*); Mt. Washington, Halfway House, 4 July '14 (*C. W. J.*); summit (*C. A. F.*).

Vt.— Woodstock, Aug. '09 (*A. P. M.*).

Mass.— Chester, 7 Oct. '12 (*C. W. J.*); Mt. Wachusett, 30 May '14 (*C. W. J.*); Salem; Sherborn (*A. P. M.*); Tyngsboro (*F. B.*); Woods Hole, 31 Aug.

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, 18 Sept. '10 (*J. B.*).

Conn.— Canterbury, 14 Aug. '05 (*B. H. W.*); Litchfield, 1 Sept. '14 (*L. B. W.*); Lyme, 4 July '11 (*H. B. K. & A. B. C.*); Portland, 15 May '14 (*B. H. W.*).

Elasmostethus cruciatus (Say).

Me.— Ft. Kent, 14 Aug. '10 (*C. W. J.*); Mt. Katahdin, July '00; Northeast Harbor, 27 Sept. '07 (*C. S. M.*); Orono, 12 June '07; Paris, 10 July '14 (*C. A. F.*); Pemaquid, 1 Aug. '06 (*H. W. F.*).

N. H.— Kearsage Village, 2 July '91 (*A. P. M.*); Mt. Washington, base, 7 July '15 (*C. W. J.*).

Vt.— St. Albans, 29 June '13 (*C. W. J.*).

Mass.— Amherst, 15 July '02.

Conn.— Eastford, 15 June '16 (*W. E. B.*); Litchfield, 5 July '08 (*L. B. W.*).

Asopinae.

Stiretrus anchorago fimbriatus (Say).

N. H.— Durham (*C. M. W. & W. F. F.*); Hampton, 11 Aug. '02 (*S. A. S.*); Pelham (*F. B.*); Rochester, 13 June '16 (*W. S.*).

Mass.— Amherst, 19 Sept. '88; Blue Hills (*W. M. M.*); Framingham, 12 June '07 (*C. A. F.*); Malden, 24 Aug. '79 (*S. H.*); Milton, 10 Aug. '25 (*Harris Coll.*); Quincy, 12 July '99; Tyngsboro (*F. B.*).

R. I.— Kingston, 24 June '14 (*J. B.*).

Conn.— Lyme, 27 Aug. '11 (*A. B. C.*).

Perillus circumcinctus Stål.

Me.— Orono, 17 May '14.

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Hampton, 2 Aug. '02 (*S. A. S.*); Newington, 24 July '12 (*W. E. B.*).

MASS.— Amherst, 23 April '08; Beach Bluff, 3 Aug. '16 (*H. M. P.*); Boston, 9 July '03 (*H. M. P.*); Forest Hills (*A. M. W.*); Framingham, 10 July '06 (*C. A. F.*); Lynn, 17 May '14 (*F. W. D.*).

CONN.— Colebrook, 10 Aug. '09 (*W. E. W.*); S. Meriden, 3 May '14 (*H. L. J.*).

Perillus exaptus (Say).

ME.— Orono, 19 May '14, 30 Aug. '13.

N. H.— Mt. Washington, base, 6 July '14 (*C. W. J.*); summit (*fide Slosson*).

MASS.— Amherst; Beach Bluff, 10 July '15 (*H. M. P.*); Blue Hills, 22 May '15 (*W. M. M.*); Milton, 15 Aug. '28 (*Harris Coll.*); Saugus, 21 June '14 (*F. W. D.*); Tyngsboro (*F. B.*).

CONN.— Gales Ferry, 26 April '13 (*D. J. C.*); New Haven, 26 April '08 (*B. H. W.*); Portland, 14 July '14 (*M. P. Z.*); S. Meriden, 10 July '14 (*H. L. J.*); Thompson, 13 July '94 (*A. P. M.*).

Rhacognathus americanus Stål.

MASS.— Wellesley, 27 June '94 (*A. P. M.*).

Mineus strigipes (Herrich-Schaeffer).

MASS.— Boston, 2 July '03 (*H. M. P.*); Framingham, 4 May '19 (*C. A. F.*); Lynn, 17 May '14 (*F. W. D.*); Nantucket, 18 Sept. '92 (*S. H.*); Southbridge, 8 June '13 (*C. W. J.*); Taunton (*G. W. P.*); Wellesley, 2 Aug. '04 (*A. P. M.*).

R. I.— Cranston; Providence, July (*C. A. D.*); Westerly.

Apateticus cynicus (Say).

ME.— Orono, 25 Aug.; Pittsfield.

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Lafayette, summit, 22 Sept. '95 (*F. B.*).

VT.— Middlebury, July '12.

MASS.— Auburndale, 19 July (*C. W. J.*); Beach Bluff, 18 July '15 (*H. M. P.*); Cambridge, 9 Sept. '37 (*Harris Coll.*); Chester, 7 Aug. '14 (*C. W. J.*); Tyngsboro, 15 Sept. (*F. B.*).

Conn.— Brookfield, 27 June '10 (*E. L. D.*); Durham, 1 Sept. '09 (*B. H. W.*); New Canaan, 29 Sept. '09 (*A. I. B.*); Portland, 15 Aug. '13 (*B. H. W.*); S. Meriden, 13 July '15 (*H. L. J.*).

Apateticus bracteatus (Fitch).

Me.— Houlton, 24 Aug. '13; Long Id., Penobscot Bay, 6 Aug. '11 (*F. A. E.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*).

Vt.— Weston, July '01.

Mass.— Amherst, 13 Aug. '94; Auburndale, 1 Oct. (*C. W. J.*); Beach Bluff, 27 Aug. '14 (*H. M. P.*); Dover, 10 Sept. '08 (*A. P. M.*); Ipswich, 31 Aug. '13 (*E. R. J.*); Mt. Greylock, 3500 ft., 17 Aug. '94 (*A. P. M.*); Nantucket, 10 Sept. '92 (*S. H.*); Salem; Sherborn, 5 Sept. '15 (*C. A. F.*).

Conn.— Litchfield, 10 Aug. '01 (*L. B. W.*); New Haven, 24 Aug. '14 (*M. P. Z.*); Prospect, 15 Aug. '06 (*W. E. B.*); S. Meriden, 2 Aug. '13 (*H. L. J.*).

Podisus maculiventris (Say).

Me.— Liberty, 16 Sept. '13 (*J. A. C.*); Norway; Orono, 18 June '08; Pownal (*O. O. S.*); Wales, 18 June (*C. A. F.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Durham, 14 Aug. '06; Mt. Washington, base, 7 July '15 (*C. W. J.*); summit (*fide Slosson*).

Vt.— Middlebury, July '12; Winooski, 25 Aug. '01 (*C. A. D.*); Woodstock, 20 Aug. '11 (*A. P. M.*).

Mass.— Amherst, 4 Aug. '05; Boston, 10 May '12 (*W. R.*); 3 Oct. '15 (*H. M. P.*); Cohasset, 13 Sept. (*O. B.*); Forest Hills, 7 May '16 (*A. M. W.*); Mt. Greylock, 27 Aug. '07 (*C. W. J.*); Nantucket, 18 Aug. '11 (*H. T. F.*); Provincetown, 6 Sept. '90 (*A. P. M.*); Rockport, 28 Aug. '13 (*C. W. J.*); Woods Hole, 25 July '05 (*J. A. C.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, 18 May '06 (*J. B.*); Providence, 10 June; Tiverton, 31 July '13 (*N. S. E.*); Warwick, 26 May; Washington, 19 June '12 (*C. W. J.*).

Conn.— Granby, 3 Oct. '05; Moosup, 29 July '14 (*C. S. M.*);

New Haven, 6 June '02 (*E. J. S. M.*); Southington, 5 July '05 (*B. H. W.*); S. Meriden, 6 July '14 (*H. L. J.*); Windsor, 26 July '05 (*W. E. B.*); Winnipauk, 4 Aug. '08 (*C. W. J.*).

Podisus fretus Olsen.

Bull. Brooklyn Ent. Soc., 1916, vol. 11, p. 82.

Mass.— Amherst, 16 May '10 (*G. P. E.*); Orleans, 13 May '91 (*F. B.*).

Podisus serieventris Uhler.

Me.— Casco Bay, 12 Sept. '12 (*G. P. E.*); Orono, 28 June '07.

N. H.— Franconia (*fide Slosson*); Mt. Washington, base, 7 July '15 (*C. W. J.*); summit, 3 July (*S. A. N.*).

Mass.— Beach Bluff, 31 Aug. '14 (*H. M. P.*); Rutland, 20 Sept. '16 (*C. W. J.*).

R. I.— Kingston, 14 Sept. '07 (*J. B.*).

Conn.— Woodstock, 13 May '15 (*W. E. B.*).

Podisus modestus (Dallas).

Me.— Capens, 12 July '07 (*C. W. J.*); Eastport, 14 July '09 (*C. W. J.*); Machias, 26 July '09 (*C. W. J.*); Monmouth, 23 June '03 (*C. A. F.*); Orono (*H. T. F.*).

N. H.— Center Harbor, 10 Sept. '14; Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Glen House, 23 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, Alpine Garden, 4 July '14 (*C. W. J.*); base, 7 July '15 (*C. W. J.*); Pelham, 5 Sept. '05 (*J. C. B.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*); Bennington, 19 July '15 (*C. W. J.*); Montgomery, 18 July '91 (*A. P. M.*); Pompanoosuc (*C. M. W.*); St. Albans, 21 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Amherst, 29 Aug. '91; Auburndale, 4 April '04 (*C. W. J.*); Bashbish Falls, 28 June (*C. W. J.*); Beach Bluff, 28 Aug. '15 (*H. M. P.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Chester, 27 May '12 (*C. W. J.*); N. Adams, 18 June '06 (*C. W. J.*); Tyngsboro (*F. B.*); Waquoit, 21 Sept. '10 (*C. W. J.*); Westford, 22 June '13 (*P. W. W.*); Winchendon, 5 July '92 (*A. P. M.*); Woods Hole, 24 July (*T. H. M.*).

R. I.— Kingston, 13 May '06, 15 Aug. '05 (*J. B.*).

Conn.— S. Meriden, 29 May '15 (*H. L. J.*).

Podisus placidus Uhler.

Me.— Capens, 12 July '07 (*C. W. J.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, base, 7 July '16 (*C. W. J.*); Webster (*W. F. F.*).

Mass.— Amherst; Blue Hills, 22 May '15 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Forest Hills, 9 May '15 (*W. M. M.*); Malden, 16 May '96 (*A. H. K.*); Orleans, 13 May '91 (F. B.); Southbridge, 16 July '14 (*C. W. J.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Colebrook (*B. H. W.*); Killingly, 11 June '15 (*W. E. B.*); Litchfield, 23 Aug. '11 (*L. B. W.*); New Haven, 22 June '11 (*A. B. C.*); N. Stonington, 20 May '15 (*I. W. D.*); Wallingford, 29 July '12 (*D. J. C.*).

Zicrona caerulea (Linné).

Me.— Newbury Neck, Surrey, 22 June '03 (*F. A. E.*).

N. H.— Mt. Washington, summit (*A. T. S.*) (*fide Van Duzee*).

COREIDAE.

Merocorinae.

Corynocoris distinctus (Dallas).

Me.— Orono, 10 May '14 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Holderness, Lake Asquam, 28 Aug. '99 (*A. P. M.*); Milford (*C. P. W.*); Webster (*W. F. F.*).

Vt.— Middlebury, July '12.

Mass.— Amherst, 21 July '05; Barnstable, 5 July '04 (*C. W. J.*); Chilmark, 17 Aug. '11 (*J. A. C.*); Fall River, 22 July '05 (*N. S. E.*); Framingham, 10 July '06 (*C. A. F.*); Truro; Tyngsboro, 2 Oct. '02 (*F. B.*); Woods Hole, 10 Sept. '15 (*W. S. A.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Kingston, Oct. '04 (*J. B.*); Plum Beach, Sept. '08.

Conn.— Litchfield, 21 Sept. '01 (*L. B. W.*); New Haven, 26 June '02 (*E. J. S. M.*); Scotland, 27 July '04 (*B. H. W.*); S. Meriden, 6 July '15 (*H. L. J.*).

Coreinae.

Tribe Acanthocephalini.

Acanthocephala terminalis (Dallas).

Mass.— Amherst, 14 July '00; Boston, 12 June '02, 8 Oct. '15 (*H. M. P.*); Dedham, 4 Sept. '08 (*C. W. J.*); Westport Factory, 31 July '13 (*C. W. J.*).

R. I.— Kingston, 5 Sept. '12 (*J. B.*).

Conn.— Brookfield, 30 Aug. '14 (*W. M.*); Greenwich, 5 Oct. '09 (*A. I. B.*); Manchester, 30 Aug. '12 (*D. J. C.*); New Haven, 4 June '11 (*W. E. B.*); S. Meriden, 6 June '14 (*H. L. J.*); Stamford, 13 Aug. '91 (*A. P. M.*).

Tribe Anisoscelini.

Leptoglossus fulvicornis (Westwood). (= *L. magnoliae* Heidemann).

Mass.— Amherst, Hatch Exp. Sta., 7 Oct. '01 (*H. T. F.*).

Tribe Mictini.

Euthochtha galeator (Fabricius).

N. H.— Durham (*C. M. W. & W. F. F.*).

Mass.— Amherst, 18 July '00; Concord, 3 Aug. '13 (*W. R.*); Dartmouth, 16 Sept. '13 (*N. S. E.*); Ellis, 24 May '12 (*C. W. J.*); Saugus, 5 Sept. '14 (*H. M. P.*); Southwick, 3 Aug. '05; Tyngsboro, 15 June '09 (*F. B.*); Westport Factory, 31 July '13 (*C. W. J.*).

R. I.— Kingston, 2 Oct. '10 (*J. B.*).

Conn.— Brookfield, 30 Aug. '14 (*W. M.*); Farmington, 6 Sept. '14 (*W. M.*); Lyme, 4 July '11 (*H. B. K. & A. B. C.*); Manchester, 12 Sept. '10 (*W. E. B.*); New Haven, 3 July '02 (*W. E. B.*); S. Meriden, 27 April '15 (*H. L. J.*); Stamford, 22 Aug. '94 (*A. P. M.*).

Tribe Coreini.

Anasa tristis (De Geer).

Common injurious species such as this are often neglected by collectors, and hence it is sometimes impossible to get an adequate number of definite records. No doubt the squash-bug is found throughout New England, wherever its food-plants are grown.

Me.— Orono, 11 May '14 (*H. M. P.*).

N. H.— Durham (*W. F. F.*).

Vt.— Williamsville, 24 June '15 (*W. T. C.*).

Mass.— Blue Hills, 15 Sept. '14 (*H. M. P.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Forest Hills, 12 April '15, 22 Sept. '14 (*H. M. P.*); Truro; Woods Hole, 12 Sept. '15 (*W. S. A.*).

R. I.— Kingston (*J. B.*).

Conn.— Berlin, 16 Sept. '15 (*W. E. B.*); Hamden, 24 June '13 (*E. M. S.*); New Haven, 26 March, 16 Oct.; Wallingford, 16 June (*J. K. L.*).

Anasa repetita Heidemann.

Mass.— Allston, 11 Sept. '11 (*C. W. J.*); Amherst; Beach Bluff, 23 June '13 (*H. M. P.*); Boston, Jamaica Plain, 13 June '13 (*N. F. P.*); Chestnut Hill, 24 Sept. '14 (*H. M. P.*).

Conn.— Wallingford, '11 (*D. J. C.*).

Anasa armigera (Say).

Mass.— Amherst, June '14 (*G. C. C.*); Boston, Chestnut Hill, 24 Sept. '14, 13 Oct. '15 (*H. M. P.*).

ALYDIDAE.

Tribe Micrelytrini.

Protenor belfragei Haglund.

Me.— Norway; Orono, 7 Aug. '13; Pushaw Lake.

N. H.— Alstead, 9 Aug. '04 (*A. P. M.*); Durham (*C. M. W. & W. F. F.*); Squam Lake, 3 Aug. '07 (*G. M. A.*).

Mass.— Amherst, 3 Aug. '88; Beach Bluff, 28 July '14 (*H. M.*

P.); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Salem, 7 Sept. '66 (*J. H. E.*); Springfield, Sept. '62; Woods Hole, 5 Sept. '15 (*W. S. A.*).

Conn.— New Haven, 20 July '08 (*B. H. W.*); Scotland, 10 Aug. '05 (*B. H. W.*); Westville, 9 Aug. '06 (*B. H. W.*).

Tribe Alydini.

Megalotomus quinquespinosus (Say).

Me.— Orono, 3 Aug. '06; S. Orrington, 28 Sept. '13 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Webster (*W. F. F.*).

Vt.— Winooski, 26 Aug. '01 (*J. B.*).

Mass.— Amherst, 31 Aug. '05; Melrose Highlands, 20 Aug. '15 (*F. X. W.*); Rutland, 20 Sept. '16 (*C. W. J.*); Sherborn, 15 July '92 (*A. P. M.*); Southbridge, 8 July '13 (*C. W. J.*); Springfield, 27 Aug. '12; Tyngsboro, 19 Sept. '91 (*F. B.*); Woods Hole, July (*T. H. M.*).

Conn.— Branford, 28 July '05 (*H. L. V.*); Canaan, 18 Aug. '94 (*A. P. M.*); Darien, 4 Aug. '08 (*C. W. J.*); Granby, 3 Oct. '05 (*B. H. W.*); New Haven, 9 July '14 (*M. P. Z.*); Portland, 15 Aug. '13 (*B. H. W.*); S. Meriden, 16 Aug. '13 (*H. L. J.*); Woodbury, 19 July '13 (*W. E. B.*).

Alydus eurinus (Say).

Me.— Orono, 19 June.

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Concord; Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Lee (*C. M. W. & W. F. F.*); Webster (*W. F. F.*).

Vt.— Wells River, 11 July '91 (*A. P. M.*); Winooski, 26 Aug. '01 (*C. A. D.*).

Mass.— Amherst, 12 July '05; Fall River, 9 July '05 (*N. S. E.*); Forest Hills, 17 Sept. '14 (*H. M. P.*); Manomet, 26 July (*C. W. J.*); Sherborn, 15 July '92 (*A. P. M.*); Tyngsboro, 19 Sept. '91 (*F. B.*); Winchendon, 5 July '92 (*A. P. M.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

R. I.— Kingston, 26 Sept. '04 (*J. B.*); Providence, 6 July (*C. A. D.*).

Conn.— Farmington, 6 Sept. '14 (*W. M.*); New Haven, 5 June '10 (*A. B. C.*); S. Meriden, 4 June '15 (*H. L. J.*); Thompson, 11 July '05 (*W. E. B.*); Yalesville, 19 Oct. '03 (*H. L. V.*).

Alydus conspersus Montandon.

Me.— Ashland (*O. O. S.*); Orono, 3 Aug. '06.

N. H.— Alstead, 8 Aug. '04 (*A. P. M.*); Durham (*C. M. W. & W. F. F.*); Hanover, 3 July '08 (*C. W. J.*); Holderness, 17 Aug. '99 (*A. P. M.*).

Mass.— Amherst, 10 Aug. '05; Beach Bluff, 24 June '14 (*H. M. P.*); Boston, 2 July '03 (*H. M. P.*); Marblehead, 17 July '14 (*H. M. P.*); Tyngsboro, 11 Sept. '91 (*F. B.*); Winchendon, 2 July '92 (*A. P. M.*).

Alydus pilosulus Herrich-Schaeffer.

Me.— Katahdin Iron Works, 8 Sept. '99 (*F. A. E.*); Orono, 8 Sept.

Mass.— Amherst; Beach Bluff, 24 June '14 (*H. M. P.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 1 Oct. '16 (*A. M. W.*); Martha's Vineyard, 17 July '03 (*J. A. C.*); Nantucket, 20 Sept. '15 (*W. S. A.*); Tyngsboro, 11 Sept. '91 (*F. B.*); Woods Hole, 19 Sept. '15 (*W. S. A.*).

R. I.— Kingston, June '05 (*J. B.*); Providence, 6 July (*C. A. D.*).

Conn.— Farmington, 6 Sept. '14 (*W. M.*); New Haven, 8 June '11 (*A. B. C.*); Poquonock, 27 June '05 (*H. L. V.*); Scotland, 25 July '04 (*B. H. W.*); Stamford, 13 Aug. '91 (*A. P. M.*).

CORIZIDAE.

Tribe HARMOSTINI.

Harmostes reflexulus (Say).

Me.— Princeton, 12 July (*C. W. J.*).

Mass.— Amherst, 2 Aug. '05; Chatham, 1 July '09 (*C. W. J.*); Forest Hills, 1 June '15 (*H. M. P.*); Hyde Park, 21 Oct. '15 (*H.

M. P.); Nantucket, 19 Aug. '09 (*J. A. C.*); Tisbury, 25 July '11 (*J. A. C.*); Tuckernuck Id., 5 Aug. '15 (*J. A. C.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*); Buttonwoods, 22 June '12 (*C. W. J.*); Kingston, 2 Aug. '05 (*J. B.*); Providence (*C. A. D.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Tribe Corizini.

Corizus hyalinus (Fabricius).

Mass.— Woods Hole, 2 July '05 (*T. H. M.*).

Corizus crassicornis (Linné).

Me.— Capens, 11 July '07 (*C. W. J.*); Ft. Kent, 19 July '10 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Lower Black River Rapids, 13 Sept. '07 (*J. A. C.*); Monmouth, 26 June '06 (*C. A. F.*); Orono, 22 April '14 (*H. M. P.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Bretton Woods, 27 June '13 (*C. W. J.*); Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Glen House, 7 July '14 (*C. W. J.*); Hanover (*C. M. W.*); Jackson, 3 July '91 (*A. P. M.*); Mt. Washington, 1 July '74 (*J. H. E.*).

Vt.— Ascutney Mt., 14 Aug. '98 (*A. P. M.*).

Mass.— Chester, 27 May '12 (*C. W. J.*).

Corizus lateralis (Say).

Me.— Orono.

N. H.— Durham (*C. M. W. & W. F. F.*).

Vt.— St. Albans, 21 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Amherst, 6 June '01; Beach Bluff, 21 June '14 (*H. M. P.*); Manomet, 5 Aug. '12 (*W. S. B.*); Rockport, 15 July '04 (*C. W. J.*); Sankaty Head, 20 Sept. '15 (*W. S. A.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Providence, 6 Oct. (*C. A. D.*).

Conn.— New Haven, 5 Nov. '10 (*D. J. C.*); Scotland, 25 July '04 (*B. H. W.*); S. Meriden, 24 May '14 (*H. L. J.*).

Corizus bohemani Signoret.

Me.— Paris, 10 July '14 (*C. A. F.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*).

Mass.— Amherst; Tyngsboro, '95 (*F. B.*).

Conn.— Meriden, 28 July '09 (*A. I. B.*); New Haven, 1 June '11 (*B. H. W.*); Scotland, 8 Aug. '05 (*B. H. W.*).

Corizus hirtus Torre Bueno.

Mass.— Nantucket, 19 Aug. '09 (*J. A. C.*).

ARADIDAE.

Aradus aequalis Say.

Vt.— (*P. S. S.*).

Aradus quadrilineatus Say.

Me.— Holden, 17 June '02 (*F. A. E.*); Monmouth (*O. O. S.*); Mt. Katahdin, Aug. '02 (*H. G. B.*); Paris, 10 July '14 (*C. A. F.*).

N. H.— Claremont; Concord; Durham; Glen House, 22 Sept. '07 (*O. B.*); Mt. Washington, summit (*fide Slosson*); Webster (*W. F. F.*).

Mass.— Amherst; Boston, 30 April '03 (*H. M. P.*); Natick, 1 Nov. '00; Saugus, 21 June '14 (*F. W. D.*); Swansea, 10 Aug. '08.

R. I.— Providence, 7 May (*C. A. D.*); Warwick, 26 May.

Conn.— Hartford, 11 May '14 (*W. M.*); Lyme, 30 April '13 (*D. J. C.*); Saybrook, 25 April '13 (*D. J. C.*); S. Meriden, 10 May '14 (*H. L. J.*).

Aradus robustus Uhler.

Me.— Manchester (*O. O. S.*); Monmouth, 27 June '01 (*C. A. F.*); Orono, 24 April '14 (*H. M. P.*).

Mass.— Amherst, 26 May '92; Cambridge, 12 Sept.; Forest Hills, 26 May '16 (*A. M. W.*); Milton, 20 May '29 (*Harris Coll.*).

R. I.— Kingston, May (*J. B.*).

Conn.— Meriden, 10 May '10 (*A. B. C.*); New Haven, 26 Feb. '11 (*A. B. C.*), 21 May '11 (*W. E. B.*); Rainbow, 7 May '14 (*M. P. Z.*); Stonington, May '14 (*M. P. Z.*).

Aradus hubbardi Heidemann.

Me.— Mt. Katahdin, 19 Aug. '02 (*H. G. B.*); Orono, 4 June '13 (*H. M. P.*).

Aradus similis Say.

Me.— Orono, 29 April, 4 June '13 (*H. M. P.*).

Mass.— Forest Hills, 8 Nov. '16 (*W. M. B.*); Springfield (*J. A. A.*); Tyngsboro, 6 May '00 (*F. B.*).

Conn.— Meriden, 8 May '11 (*A. B. C.*); Stonington, May '14 (*I. W. D.*).

Aradus acutus Say.

Me.— Norway (*O. O. S.*).

N. H.— Aug. '50 (*Harris Coll.*); Temple, 26 May '00 (*F. B.*).

Aradus borealis Heidemann.

N. H.— Mt. Washington, Lake of the Clouds, 2 July '96 (*F. B.*).

Aradus tuberculifer Kirby, Bergroth.

Me.— Orono (*H. T. F.*).

Aradus uniformis Heidemann.

Mass.— Chicopee, 25 June '03.

Aradus lugubris Fallén.

Me.— Mt. Katahdin, 3000 ft., Aug. '02 (*H. G. B.*); Norway; Orono, 10 May '14 (*H. M. P.*).

N. H.— Milford (*C. P. W.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Amherst; Boston, 11 July '78; Beach Bluff, June 25.

R. I.— Kingston, 17 June '06 (*J. B.*).

Aradus abbas Bergroth.

Me.— Ashland Junction, 16 Aug. '10 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*); Machias, 17 Aug. (*C. W. J.*); Mt. Katahdin, Aug. '02 (*H. G. B.*).

Vt.— St. Johnsbury, 27 June '06 (*C. W. J.*).

Mass.— Boston, 1 Sept.; Concord, 26 April '13 (*W. R.*).

Conn.— New Haven, 24 April '15 (*Q. S. L.*); 31 July '11 (*A. B. C.*); Wallingford, 5 June '12 (*D. J. C.*).

Aradus niger Stål.

Me.— Orono, 29 April '14, 27 May '13 (*H. M. P.*); Mt. Katahdin, Aug. '02 (*H. G. B.*).

N. H.— Crawfords, 26 Sept. '16 (*H. M. P.*).

Mass.— (*S. H.*).

MEZIRIDAE.

Tribe Mezirini.

Neuroctenus simplex (Uhler).

Me.— Orono (*H. T. F.*).

Mass.— (*H. T. F.*).

Aneurus inconstans Uhler.

Me.— Orono, 24 Sept.

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 2 Oct. '16 (*H. M. P.*).

Vt.— Montpelier, 25 June '06 (*C. W. J.*).

Mass.— Amherst; Beach Bluff, 18 July '14 (*H. M. P.*); Boston, 3 Feb. '04 (*H. M. P.*); Cambridge, 19 Nov. '69 (*E. B.*); Milton, 29 May '22 (*Harris Coll.*).

R. I.— Providence, April, 11 June '06 (*C. A. D.*).

Conn.— Lyme, 14 May '11 (*A. B. C.*).

Aneurus simplex Uhler.

Vt.— (*P. S. S.*).

Aneurus fiskei Heidemann.

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

NEIDIDAE.

Neidinae.

Neides muticus (Say).

Me.— Monmouth, 16 June (*C. A. F.*); Orono, 10 June '13 (*C. P. A.*); Paris, 9 July '14 (*C. A. F.*).

Mass.— Amherst; Boston, Chestnut Hill, 24 Sept. '15 (*H. M. P.*);

Danvers, 3 Aug. '15 (*H. M. P.*); Forest Hills, 19 Sept. '15 (*H. M. P.*); Framingham, 18 April '09 (*C. A. F.*); Freetown, 17 July '08 (*C. W. J.*); Williamsburg, 7 Aug. '11 (*C. W. J.*).

CONN.— Meriden, 29 April '07 (*B. H. W.*); New Haven, 30 July '09 (*B. H. W.*); Woodbridge, 12 May '07 (*W. E. B.*).

METACANTHINAE.

Jalysus spinosus (Say).

ME.— Bangor, 6 June (*F. A. E.*).

MASS.— Amherst (*G. C. C.*); Beach Bluff, 4 July '15 (*H. M. P.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Cohasset, 13 Sept. '07 (*O. B.*); Dedham, 20 May (*C. W. J.*); Saugus, 5 Sept. '14 (*H. M. P.*); Tyngsboro, June '01 (*F. B.*); Woods Hole, July (*T. H. M.*).

R. I.— Cumberland, 3 July '10 (*J. B.*); Kingston, May '06 (*J. B.*).

CONN.— New Haven, 26 Feb. '11 (*A. B. C.*); Rainbow, 29 May '15 (*B. H. W.*).

LYGAEIDAE.

LYGAEINAE.

Tribe LYGAEINI.

Oncopeltus fasciatus (Dallas).

MASS.— Beach Bluff, 27 July '13 (*H. M. P.*); Malden, 1 Sept. '70 (*S. H.*).

CONN.— S. Meriden, 11 Sept. '13 (*H. L. J.*); Stamford, 13 Aug. '91 (*A. P. M.*); Stonington, July '09 (*G. H. H.*).

Lygaeus turcicus Fabricius.

MASS.— Lynn, 2 Sept. '14 (*H. M. P.*).

Lygaeus kalmi Stål.

ME.— Green Lake, near Holden, 27 July '09 (*F. A. E.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Durham

(*C. M. W. & W. F. F.*); Glen House, 15 July '15 (*C. W. J.*); Hanover, 10 Aug. '01; Jackson, 22 Sept. '07 (*O. B.*); Mt. Washington, summit (*fide Slosson*); N. Conway, 30 July '91 (*A. P. M.*); Pelham (*F. B.*); Webster (*W. F. F.*).

Vt.— Norwich, 4 July '08 (*C. W. J.*); Woodstock, 13 Aug. '10 (*A. P. M.*).

Mass.— Amherst, 17 Aug. '05; Beach Bluff, 4 July '12 (*H. M. P.*); Lynn, 17 May '14 (*F. W. D.*); Forest Hills, 21 Mar. '13; Medford, 3 Oct. '02 (*C. A. F.*); Truro; Tyngsboro, 29 June '90 (*F. B.*); Woods Hole, 9 Sept. '15 (*W. S. A.*).

R. I.— Buttonwoods, 20 June '12 (*C. W. J.*).

Conn.— Farmington, 21 May '14 (*W. M.*); Hartford, 12 Sept. '07 (*W. E. B.*); New Canaan, 26 Sept. '06 (*W. E. B.*); New Haven, 15 July '99 (*W. E. B.*); S. Meriden, 16 April '15 (*H. L. J.*); Stamford, 13 Aug. '91 (*A. P. M.*); Stonington, July '09 (*G. H. H.*).

Lygaeus albulus Distant.

Mass.— Saugus, 22 Aug. '14 (*H. M. P.*); Nantucket, 9 Sept. '09 (*H. T. F.*); Woods Hole, July '98 (*fide Barber*).

R. I.— Cumberland, 3 July '10 (*J. B.*).

Tribe Orsillini.

Ortholomus longiceps Stål.

Me.— Liberty, 16 Sept. '13 (*J. A. C.*); Orono, 10 Sept. '06; Portland (*P. R. U.*) (*fide Uhler*).

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Holderness, 1 Aug. '99 (*A. P. M.*).

Mass.— Beach Bluff, 10 July '15 (*H. M. P.*); Provincetown, 7 Sept. '07 (*A. P. M.*); Southwick, 3 Aug. '05.

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Nysius californicus Stål.

Conn.— New Haven, 20 July '04 (*B. H. W.*).

Nysius thymi (Wolff).

Me.— Machias, 19 July '09 (*C. W. J.*); Paris, 4 July '15 (*C. A. F.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Dublin, 1 Aug.; Hanover, 3 July '15 (*C. W. J.*); N. Conway, 30 July '91 (*A. P. M.*); Wonalancet, 13 Sept. '12 (*J. A. C.*).

Vt.— Wells River, 11 July '91 (*A. P. M.*).

Mass.— Warwick.

Nysius ericae (Schilling).

Me.— Naples, 1 July '13 (*C. W. J.*); Orono, 28 Sept.; Westbrook (*O. O. S.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Dublin, 1 Aug. (*C. W. J.*); Durham (*C. M. W. & W. F. F.*); Hanover, 8 July '08 (*C. W. J.*); Littleton (*C. M. W.*); N. Conway, 30 July '91 (*A. P. M.*); Webster (*W. F. F.*).

Vt.— Mt. Equinox, 5 June '10 (*C. W. J.*); Wells River, 11 July '91 (*A. P. M.*).

Mass.— Amherst, 19 June '95; Beach Bluff, 27 Aug. '14 (*H. M. P.*); Blue Hills, 22 May '15 (*H. M. P.*); Cohasset, 8 Sept. (*O. B.*); Squantum, 3 Oct. '14 (*H. M. P.*); Tisbury, 25 July '11 (*J. A. C.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); New Haven, 4 Aug. '09 (*B. H. W.*); Poquonock, 27 June '05 (*H. L. V.*); Rainbow, 14 May '15 (*M. P. Z.*).

Belonochilus numenius (Say).

Mass.— Milton, 1 Sept. '29 (*Harris Coll.*); Woods Hole (*T. H. M.*).

Cyminae.

Tribe Ischnorrhynchini.

Ischnorrhynchus geminatus (Say).

Me.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono, 22 May '14 (*H. M. P.*); Township 4, Range 7, Penobscot Co., 1 Aug. '10 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Jackson, 22 Sept. '07 (*O. B.*);

Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*); Webster (*W. F. F.*).

MASS.— Amherst; Chester, 8 Aug. '12 (*C. W. J.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Framingham, 16 April '14 (*C. A. F.*); Franklin, 26 May '16 (*H. M. P.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Nantucket, 16 Aug. '11 (*H. T. F.*); Provincetown, 1 Sept. '14 (*C. W. J.*); Woods Hole.

CONN.— Brookfield, 27 July '10 (*E. L. D.*); New Haven, 4 May '04 (*H. L. V.*); Portland, 13 Aug. '13 (*B. H. W.*); Rainbow, 9 May '12 (*B. H. W.*).

Tribe CYMINI.

Cymus luridus Stål.

ME.— Eastport, 15 July '09 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Orono, 24 May; S. Harpswell, 27 July '08 (*J. A. C.*).

N. H.— Mt. Washington, summit (*fide Slosson*).

VT.— Mt. Mansfield, 4000 ft., 21 July '91 (*A. P. M.*).

MASS.— Beach Bluff, 21 June '15 (*H. M. P.*); Edgartown, 28 June '12 (*C. W. J.*); Gloucester, 22 May '15 (*C. W. J.*); Nantucket, 6 Aug. '13 (*J. A. C.*); Provincetown, 1 Sept. '14 (*C. W. J.*); Tuckernuck Id., 6 Aug. '09 (*J. A. C.*); Woods Hole, July (*T. H. M.*).

R. I.— Buttonwoods, 17 June '12 (*C. W. J.*).

CONN.— New Haven, 17 May '06 (*B. H. W.*); Stony Creek, 27 July '04 (*H. L. V.*).

Cymus angustatus Stål.

ME.— Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Liberty, 13 Sept. '13 (*J. A. C.*); Monmouth, 23 June '07 (*C. A. F.*); Naples, 1 July '13 (*C. W. J.*); Orono.

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover, 3 July '15 (*C. W. J.*); Mt. Washington (*W. F. F.*); Webster (*W. F. F.*).

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Mt. Mansfield, 4000 ft., 21 June '91 (*A. P. M.*); St. Albans, 21 June '13 (*C. W. J.*).

MASS.— Amherst; Chilmark, 7 Aug. '11 (*J. A. C.*); Forest Hills, 20 May '15 (*H. M. P.*); Nantucket, 19 Aug. '09 (*J. A. C.*);

N. Adams, 20 June '08 (*C. W. J.*); Provincetown, 29 June '91 (*A. P. M.*); Springfield, 14 July '05 (*C. W. J.*); Tuckernuck Id., 6 Aug. '09 (*J. A. C.*); Woods Hole, July (*T. H. M.*).

R. I.— Buttonwoods, 15 June '12 (*C. W. J.*); Cumberland, 3 July '10 (*J. B.*).

CONN.— Brookfield, 27 July '10 (*E. L. D.*); Danbury, 15 June '09 (*C. W. J.*); New Haven, 26 Feb. '11 (*A. B. C.*); Thompson, 11 July '05 (*H. L. V.*).

Cymus discors Horváth.

ME.— Eastport, 15 July '09 (*C. W. J.*); Holden, 20 July '00 (*F. A. E.*); Machias, 22 July '09 (*C. W. J.*); Orono, 31 May '14 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover, 3 July '15 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

VT.— Burlington, 22 June '06 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Highgate Springs (*fide Horváth*); St. Albans, 21 June '13 (*C. W. J.*).

MASS.— Beach Bluff, 21 June '15 (*H. M. P.*); Edgartown, 28 June '12 (*C. W. J.*); Pocasset, 6 Aug. '12 (*J. A. C.*); Sherburn, 6 Jan. '17 (*C. A. F.*); Tisbury, 25 July '11 (*J. A. C.*); Wellesley, 15 Aug. '00 (*A. P. M.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*).

BLISSINAE.

Ischnodemus falicus (Say).

MASS.— Beach Bluff, 22 June '14 (*H. M. P.*); Cohasset, 13 Sept. '07 (*O. B.*); Tyngsboro, Jan. '98 (*F. B.*); Woods Hole, July (*T. H. M.*).

CONN.— Orange, 21 May '11 (*B. H. W.*).

Blissus leucopterus (Say).

MASS.— Amherst, 26 June '00; Beach Bluff, 21 June '15, 26 July '14 (*H. M. P.*); Nantucket, 9 Sept. '09 (*H. T. F.*); Woods Hole, July (*T. H. M.*).

R. I.— Providence, Sept. '15 (*J. B.*).

Conn.— New Haven, 11 Aug. '08 (*B. H. W.*); Orange, 21 May '11 (*B. H. W.*); S. Meriden, 15 April '14 (*H. L. J.*).

Blissus hirtus Montandon.

Me.— Harbor, 20 April '12 (*S. L. M.*); Orono, 7 April '12, 12 June '13 (*H. M. P.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*).

Mass.— Forest Hills, 20 May '15, 14 Sept. '14 (*H. M. P.*); Hazelwood, 10 Aug. '00 (*A. P. M.*); Salem, 6 April '91 (*A. P. M.*); Tisbury, 5 Aug. '11 (*J. A. C.*).

Conn.— Stamford, 13 Aug. '91 (*A. P. M.*).

Geocorinae.

Geocoris bullatus (Say).

Me.— Orono, 15 June; Pownal (*O. O. S.*); Paris, 7 July '15 (*C. A. F.*).

N. H.— Mt. Washington, summit (*fide Slosson*).

Vt.— Wells River, 11 July '91 (*A. P. M.*).

Mass.— Amherst; Beach Bluff, 21 June '15 (*H. M. P.*); Boston, 19 Nov. '77 (*S. H.*); Framingham, 17 June '15 (*C. A. F.*); Winchendon, 1 July '92 (*A. P. M.*).

Conn.— New Haven, 10 June '07 (*J. B.*).

Geocoris bullatus discopterus Stål.

Me.— Paris, 10 July '15 (*C. A. F.*).

N. H.— Bretton Woods, 18 June '12 (*C. W. J.*); Webster (*W. F. F.*).

Vt.— S. Hero, Grand Isle, 9 July '04 (*A. P. M.*).

Mass.— Beach Bluff, 21 June '15, (*H. M. P.*); Forest Hills, 28 June '79 (*S. H.*); Somerville, 4 Sept. '90 (*A. P. M.*).

Conn.— New Haven, 19 July '04 (*P. L. B.*), 3 Aug. '05 (*B. H. W.*).

Geocoris uliginosus (Say).

Me.— Paris, 10 July '15 (*C. A. F.*); Pownal, 4 July (*O. O. S.*);

Township 4, Range 7, Penobscot Co., 1 Aug. '10 (*J. A. C.*); Westbrook, 13 Sept. (*O. O. S.*).

N. H.— Durham, July '00 (*W. F. F.*).

Mass.— Forest Hills, 31 Mar. '15 (*S. L. M.*); Provincetown, 27 June '91 (*A. P. M.*); Sherborn, 6 Jan. '17 (*C. A. F.*); Wellesley, 14 Sept. '98 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

Geocoris uliginosus speculator Montandon.

N. H.— White Mts. (*W. F. F.*).

Mass.— Beach Bluff, 18 July '15 (*H. M. P.*); Lowell (*fide Montandon*).

Conn.— New Haven, 9 July '11 (*B. H. W.*).

Geocoris uliginosus lateralis (Fieber).

Mass.— Sherborn, 6 Sept. '14 (*C. A. F.*).

Geocoris uliginosus limbatus Stål.

Me.— Naples, 1 July '13 (*C. W. J.*); Paris, 10 July '15 (*C. A. F.*).

N. H.— Webster (*W. F. F.*).

Vt.— Woodstock, 26 Oct. '09 (*A. P. M.*).

Mass.— Beach Bluff, 21 June '15 (*H. M. P.*); Edgartown, 27 Aug. '12 (*C. W. J.*); Framingham, 20 Aug. '15 (*C. A. F.*); Nantucket, 9 Sept. '09 (*H. T. F.*); Provincetown, 1 Sept. '14 (*C. W. J.*); Sherborn, 3 April '92 (*A. P. M.*).

Isthmocoris piceus (Say).

Mass.— Andover (*fide McAtee*); Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 18 May '15 (*F. X. W.*); Sherborn, 12 June '15 (*C. A. F.*); Tyngsboro, 1 Mar. '01 (*F. B.*); Wellesley, 6 Sept. '00 (*A. P. M.*).

R. I.— Tiverton, 25 May '07 (*N. S. E.*).

Conn.— Hamden, 24 April '11 (*B. H. W.*); Portland (*fide McAtee*).

Pachygronthinae.

Phlegyas abbreviatus (Uhler).

Me.— Calais, 10 July (*C. W. J.*); Holden, 23 June '01 (*F. A. E.*); Orr's Id., 25 July '09 (*C. W. J.*); Paris, 15 July '14 (*C. A. F.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Holderness, 3 Aug. '99 (*A. P. M.*); Littleton (*C. M. W.*); Mt. Washington (*W. F. F.*); Nottingham (*C. M. W. & W. F. F.*); Twin Mt. (*W. F. F.*).

Vt.— Dummerston, 14 July '08 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Amherst, 5 July '97; Blue Hills, 15 Sept. '14 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Edgartown, 28 June '12 (*C. W. J.*); Forest Hills, 28 March '15 (*W. M.*); Nantucket, 4 July '04 (*J. A. C.*); Provincetown, 6 Sept. '90 (*A. P. M.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, 2 July '05 (*J. A. C.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Cumberland (*J. B.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Litchfield, 1 July '16 (*L. B. W.*); New Haven, 1 June '11, 17 July '08 (*B. H. W.*); Middlebury, 16 June '11 (*B. H. W.*); S. Meriden, 25 May '14 (*H. L. J.*).

Oedancala dorsalis (Say).

Me.— (*fide Stover*).

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Wonalancet, 13 Sept. '12 (*J. A. C.*).

Vt.— St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Beach Bluff, 25 June '15 (*H. M. P.*); Forest Hills, 28 May '15, 4 Oct. '15 (*H. M. P.*); Framingham, 30 May '08 (*C. A. F.*); Woods Hole, July (*T. H. M.*).

R. I.— Apponaug, 22 June '12 (*C. W. J.*); Buttonwoods, 18 June '12 (*C. W. J.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Darien, 27 May '15 (*C. W. J.*); Lyme, 20 Aug. '10 (*B. H. W.*); New Haven, 26 May '11 (*A. B. C.*); S. Meriden, 7 June '14 (*H. L. J.*); Wallingford, 8 June '11 (*B. H. W.*).

Oxycareninae.

Crophius disconotus (Say).

Me.— Liberty, 13 Sept. '13 (*J. A. C.*).

N. H.— Crawfords, 3 Oct. '16 (*H. M. P.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Beach Bluff, 21 June '14 (*H. M. P.*); Forest Hills, 14 Sept. '14 (*H. M. P.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Tyngsboro, 13 Mar. '98 (*F. B.*); Wollaston, 27 Oct. '95 (*F. H. S.*).

Rhyparochrominae.

Tribe Myodochini.

Myodochus serripes Olivier.

Me.— Orono, 24 May '14 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*).

Vt.— S. Hero, Grand Isle, 7 July '04 (*A. P. M.*).

Mass.— Blue Hills, 22 May '15 (*W. H. C.*); Boston, 26 May '03 (*H. M. P.*); Framingham, 21 Jan. '06 (*C. A. F.*); Milton, 25 March '28 (*Harris Coll.*); Swampscott, 19 Aug. '14 (*H. M. P.*); Woods Hole, July (*T. H. M.*).

Conn.— East River, 15 July '08 (*C. R. E.*); Farmington, 18 Aug. '14 (*W. M.*); Lyme, 30 April '11 (*A. B. C.*); New Haven, 17 June '02 (*E. J. S. M.*); Wallingford, 23 Nov. '12 (*H. B. K.*); Winnipauk, 12 June '15 (*C. W. J.*).

Heraeus plebejus Stål.

Mass.— Brookline, 25 Sept. '13 (*C. W. J.*); Cambridge; Tyngsboro, 13 Mar. '98 (*F. B.*).

Conn.— New Haven, 7 May '11 (*A. B. C.*).

Sphaerobius insignis (Uhler).

Me.— Fryeburg, 20 Aug. '92 (*A. P. M.*); Machias, 2 July (*C. W. J.*); Westbrook, 25 Sept. (*O. O. S.*).

N. H.— Hanover (*C. M. W.*); Mt. Washington (*A. T. S.*) (*fide Barber*).

Ligyrocoris diffusus (Uhler).

Me.— Calais, 10 July (*C. W. J.*); Liberty, 13 Sept. '13 (*J. A. C.*); Orono, 15 Sept. '13 (*H. M. P.*); Paris, 10 July '14 (*C. A. F.*); Township 4, Range 7, Penobscot Co., 1 Aug. '10 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Dublin, 1 Aug. (*C. W. J.*); Glen House, 20 July '15 (*C. W. J.*); Hampton (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Holderness, 1 Aug. '99 (*A. P. M.*); Jackson, 22 Sept. '07 (*O. B.*); Mt. Washington, 5000 ft., Lake of the Clouds, 5 July '14 (*C. A. F.*).

Vt.— Ascutney Mt., 23 July '12 (*C. W. J.*); Montgomery, 18 July '91 (*A. P. M.*); Norwich (*C. M. W.*); S. Hero, Grand Isle, July '04 (*A. P. M.*).

Mass.— Amherst; Beach Bluff, 21 June '15 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Forest Hills, 30 Sept. '15 (*H. M. P.*); Nantucket, 9 Sept. '09 (*H. T. F.*); Newton, 16 June '14 (*J. R. T. B.*); Provincetown, 7 Sept. '07 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*); Kingston, 25 July '05 (*J. B.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Colebrook, 21 July '05 (*H. L. V.*); New Haven, 28 June '11 (*B. H. W.*); Thompson, 3 Aug. '92 (*A. P. M.*).

Ligyrocoris contractus (Say).

Me.— Belfast, 21 June '12 (*J. A. C.*); Bowlin Pond, 31 July '10 (*J. A. C.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Mistake Id., 9 Aug. '07 (*J. A. C.*); Orono, 12 Sept. '13 (*H. M. P.*); Paris, 15 July '14 (*C. A. F.*); Roque Bluff, 15 Aug. '07 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Glen House, 20 July '15 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*); Wonalancet, 13 Sept. '12 (*C. W. J.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*); Ascutney Mt., 11 July '08 (*C. W. J.*); Jay, 17 July '91 (*A. P. M.*); Stratton, 10 July '13 (*P. W. W.*).

Mass.— Peru, 28 Aug. '04 (*J. B.*).

Perigenes constrictus (Say).

N. H.— Hampton.

Mass.— Amherst; Beach Bluff, 31 Aug. '14 (*H. M. P.*); Milton, 15 Aug. '31 (*Harris Coll.*); Nahant, 16 July '15 (*H. M. P.*); Newton, 16 June '14 (*J. R. T. B.*); Provincetown, 8 Sept. '90 (*A. P. M.*); Saugus, 2 Sept. '15 (*H. M. P.*); Wellesley, 6 Oct. '93 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

Perigenes costalis Van Duzee.

N. H.— Durham (*C. M. W. & W. F. F.*).

Mass.— Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Mt. Tom, 22 Sept. '05 (*C. W. J.*).

Conn.— S. Meriden, 6 July '14 (*H. L. J.*).

Orthaea basalis (Dallas).

Mass.— Boston, 8 May '15 (*W. M.*); Framingham, 19 April '14 (*C. A. F.*); Tyngsboro (*F. B.*).

Conn.— Rainbow, 9 May '12 (*B. H. W.*).

Ptochiomera nodosa Say.

Mass.— Woods Hole, July (*T. H. M.*).

Carpilis ferruginea Stål.

Me.— Orono (*H. T. F.*).

Cnemodus mavortius (Say).

Me.— Skowhegan, 19 June (*O. O. S.*).

Mass.— Beverly, 22 Aug. '09 (*C. W. J.*); Cambridge (*Harris Coll.*); Freetown, 3 Aug. '08 (*N. S. E.*); Wellesley, 4 Nov. '03 (*A. P. M.*); West Chop, 6 Aug. '93 (*A. P. M.*); Woods Hole (*T. H. M.*) (*fide Montgomery*).

Conn.— Lyme, 12 March '11 (*A. B. C.*); S. Meriden, 18 May '15 (*H. L. J.*).

Pseudocnemodus canadensis (Provancher).

Mass.— Beach Bluff, 15 Aug. '14 (*H. M. P.*); Manomet, 13 Aug. '12 (*W. S. B.*); Saugus, 5 Sept. '14 (*H. M. P.*); Tisbury, 31 July '11 (*J. A. C.*); Tyngsboro (*F. B.*); Waquoit, 21 Sept. '10 (*C. W. J.*); Woods Hole, 25 July '05 (*J. A. C.*).

Tribe RHYPAROCHROMINI.

Ozophora picturata Uhler.

N. H.— Massabesic Lake, 10 Oct. '93 (*F. B.*).

MASS.— Cambridge, 9 April '35 (*Harris Coll.*); Cohasset, 13 Sept. (*O. B.*); Forest Hills, 14 April '17 (*W. M. M. & W. M. B.*); Tyngsboro, 20 Oct. '98 (*F. B.*).

CONN.— New Haven, 11 March '11 (*A. B. C.*).

Antillocoris pilosulus (Stål).

MASS.— Tyngsboro (*F. B.*).

Antillocoris pallidus (Uhler).

ME.— Orono, 22 April '13 (*H. M. P.*).

MASS.— Cambridge, 12 Sept. '73; Framingham, 10 July '05 (*C. A. F.*); Nahant, 7 July '16 (*H. M. P.*); Sherborn (*C. A. F.*); Tewksbury; Tyngsboro, April '96 (*F. B.*); Wollaston, 27 Oct. '95 (*F. H. S.*).

CONN.— New Haven, 5 June '16 (*M. P. Z.*).

Rhyparochromus plenus Distant.

MASS.— Beach Bluff, 18 July '15, 1 Aug. '16 (*H. M. P.*); Mt. Tom, 14 July '05 (*C. W. J.*).

CONN.— Georgetown (*fide Barber*).

Plinthisus americanus Van Duzee.

N. H.— Franconia.

MASS.— Tyngsboro (*F. B.*).

Peritrechus fraternus Uhler.

N. H.— Hampton.

MASS.— Beverly, June (*E. B.*); Nantucket, 19 Aug. '09 (*J. A. C.*); Somerset, 29 May '09 (*N. S. E.*); Tyngsboro, 10 Jan. '97 (*F. B.*).

Tribe GONIANOTINI.

Emblethis vicarius Horváth.

N. H.— Hampton.

MASS.— Beach Bluff, 28 June '15 (*H. M. P.*); Framingham, 3 May '14 (*C. A. F.*); Readville, 2 Sept. '79; Springfield (*S. S.*); Tyngsboro, April '01 (*F. B.*).

R. I.— Portsmouth, 4 Sept. '13 (*N. S. E.*).

Conn.— Lyme, 1 May '10 (*A. B. C.*); N. Windham, 14 July '94 (*A. P. M.*); S. Meriden, 5 March '15 (*H. L. J.*); Waterford, 18 July '14 (*I. W. D.*).

Tribe Beosini.

Trapezonotus arenarius (Linné).

Mass.— Boston, City Point, 8 May '14 (*W. M.*).

Sphragisticus nebulosus (Fallén).

Me.— Pownal, 3 Sept. (*O. O. S.*).

Mass.— Amherst; Beach Bluff, 22 Aug. '14 (*H. M. P.*); Forest Hills, 3 June '16 (*A. M. W.*).

Delochilocoris umbrosus (Distant).

Mass.— Tyngsboro (*F. B.*).

Conn.— Orange, 21 May '11 (*B. H. W.*); Wallingford, 5 June '12 (*D. J. C.*); Windsor, 18 July '04 (*B. H. W.*).

Tribe Lethaeini.

Drymus unus (Say).

Me.— Liberty, 13 Sept. '13 (*J. A. C.*); Northeast Harbor, 27 Sept. '07 (*C. S. M.*); Orono.

N. H.— Alton (*F. B.*); Center Harbor, 10 Sept. '14; Mt. Lafayette, summit, 22 Sept. '95 (*F. B.*); Mt. Washington, summit (*fide Slosson*); Sunapee (*F. B.*).

Mass.— Berlin, 8 Aug. '15 (*C. A. F.*); Fall River, 27 March '09 (*N. S. E.*); Forest Hills, 16 Sept. '14 (*H. M. P.*); Framingham, 10 July '05 (*C. A. F.*); Tyngsboro, Oct. '93 (*F. B.*).

Drymus crassus Van Duzee.

N. H.— Mt. Washington (*A. T. S.*) (*fide Van Duzee*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Eremocoris ferus (Say).

Me.— Capens, 14 July '07 (*C. W. J.*); Holden, 27 April '01 (*F. A. E.*); Monmouth, 16 June (*C. A. F.*); Orono.

N. H.— Durham (*C. M. W. & W. F. F.*); Littleton, 15 Oct. '97 (*F. B.*); Mt. Washington, Lake of the Clouds, 2 July '96 (*F. B.*); Sunapee.

Vt.— Manchester, 8 June '10 (*C. W. J.*).

Mass.— Amherst, 2 Aug. '97; Beach Bluff, 21 June '15 (*H. M. P.*); Boston, 19 April '15 (*H. M. P.*); Edgartown, 29 June '12 (*C. W. J.*); Fall River, 8 Oct. '09 (*N. S. E.*); Forest Hills, 8 Oct. '14 (*H. M. P.*); Ipswich, 16 Oct.; S. Natick, 26 Oct. '05 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

Conn.— Orange, 21 May '11 (*B. H. W.*); Oxford, 21 May '04 (*W. E. B.*); Wallingford, 8 June '11 (*B. H. W.*).

Scolopostethus thomsoni Reuter.

N. H.— Mt. Washington, 2 July '96 (*F. B.*).

Mass.— Tyngsboro (*F. B.*).

Scolopostethus atlanticus Horváth.

Me.— Orono, 29 March '14 (*H. M. P.*); Princeton, 12 July '09 (*C. W. J.*).

Mass.— Danvers, 3 Aug. '15 (*H. M. P.*); Tyngsboro, 22 Oct. '95 (*F. B.*); Woods Hole, 11 Aug. '05 (*J. A. C.*).

R. I.— Cumberland (*J. B.*).

Conn.— New Haven, 15 May '11 (*A. B. C.*).

Scolopostethus diffidens Horváth.

Me.— 30 April '07.

Mass.— Berlin, 8 Aug. '15 (*C. A. F.*); Cambridge, 12 Sept. '13; Framingham, 3 May '14 (*C. A. F.*).

Xestocoris nitens Van Duzee.

Me.— Orono, 22 April '13 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Littleton, 15 Oct. '97 (*F. B.*).

Mass.— Tyngsboro, 19 Feb. '11 (*F. B.*); Wellesley, 19 May '05 (*A. P. M.*).

Conn.— Lyme, 30 April '11 (*A. B. C.*).

Cryphula parallelogramma Stål.

Mass.— Fall River, 28 March '08 (*N. S. E.*); Forest Hills, 24 March '15 (*H. M. P.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Tyngsboro, 7 Mar. '01 (*F. B.*).

Conn.— New Haven, 26 Feb. '11 (*A. B. C.*).

PIESMIDAE.

Piesma cinerea (Say).

Mass.— Amherst, 6 April '00; Beach Bluff, 21 June '15 (*H. M. P.*); Cambridge.

R. I.— Kingston, 29 July '08 (*J. B.*).

Conn.— Hamden, 23 Aug. '10 (*W. E. B.*); Manchester, 18 Sept. '11 (*W. E. B.*); Milford, 11 July '16 (*W. E. B.*); New Haven, 4 Aug. '09 (*H. B. W.*); Stonington, 30 Dec. '13 (*I. W. D.*).

TINGIDAE.

Tribe TINGINI.

Acalypta lillianis Torre Bueno.

Bull. Brooklyn Ent. Soc., 1916, vol. 11, p. 39.

Me.— The Forks, 16 June '00 (*O. O. S.*).

N. H.— (*fide Osborn and Drake*).

Dictyonota tricornis americana Parshley.

Psyche, 1916, vol. 23, p. 164.

Me.— Eastport, 15 July '09 (*C. W. J.*); Machias, 26 July '06 (*C. W. J.*); Roque Bluff, 15 July '07 (*J. A. C.*).

Corythucha ciliata (Say).

Me.— (*A. S. P.*) (*fide Packard*).

MASS.— Melrose Highlands, 15 Jan. '16 (*R. T. W.*); Nantucket, 19 Aug. '09 (*J. A. C.*); Needham, 3 Sept. '11.

R. I.— Kingston, July '05 (*J. B.*).

CONN.— Hartford, 26 Sept. '10 (*G. H. H.*); Mystic, 4 March '15 (*M. P. Z.*); New Canaan, 14 Sept. '05 (*W. E. B.*); New Haven, 3 Aug. '09 (*B. H. W.*); N. Stonington, 21 Jan. '15 (*M. P. Z.*); S. Meriden, 8 March '14 (*H. L. J.*).

Corythucha arcuata (Say).

N. H.— Durham (*C. M. W. & W. F. F.*); Hampton, 27 May '10 (*S. A. S.*).

MASS.— Auburndale, 22 July (*C. W. J.*); Beverly, 24 Oct. '66 (*E. B.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Cohasset, 8 Sept. (*O. B.*); Sherborn, 5 Aug. '96 (*A. P. M.*); Squantum, 3 Oct. '14 (*H. M. P.*).

R. I.— Kingston, 1 June '05 (*J. B.*).

CONN.— Brookfield, 27 July '10 (*E. L. D.*); Litchfield, 1 Sept. '14 (*L. B. W.*); Mystic, 4 March '15 (*M. P. Z.*); New Haven, 19 Sept. '10 (*W. E. B.*); Portland, 14 Aug. '14 (*B. H. W.*).

Corythucha crataegi Morrill.

MASS.— Beach Bluff, 1 Aug. '16 (*H. M. P.*); Cohasset, 15 Sept. (*O. B.*); Ellis, 24 May '15 (*C. W. J.*); Needham, 3 Sept. '11; Wellesley, Oct. '03 (*A. P. M.*).

CONN.— New Haven, 9 July '11 (*B. H. W.*).

Corythucha pergandei Heidemann.

ME.— Orono, 17 Sept. '13 (*H. M. P.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Fabyans (*W. F. F.*).

MASS.— Springfield, 29 Aug. '02; Tuckernuck Id., 5 Aug. '13 (*J. A. C.*).

CONN.— Brookfield, 27 July '10 (*E. L. D.*); Chapinville, 26 May '04 (*W. E. B.*); Pine Orchard, 26 July '04 (*W. E. B.*).

Corythucha marmorata (Uhler).

ME.— Princeton, 12 July '09 (*C. W. J.*).

N. H.— Bretton Woods, 18 June '12 (*C. W. J.*); Durham (*C. M. W. & W. F. F.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Amherst; Beach Bluff, 25 June '14 (*H. M. P.*); Blue Hills, 16 June (*C. W. J.*); Chilmark, 14 Aug. '11 (*J. A. C.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Forest Hills, 8 Oct. '14 (*H. M. P.*); Southbridge, 16 July '14 (*C. W. J.*); Tisbury, 27 June '11 (*J. A. C.*); Woods Hole, 1 July '05 (*J. A. C.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Kingston, 20 July '05 (*J. B.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Granby, 1 July '14; New Haven, 23 June '12 (*W. E. B.*); S. Meriden, 12 June '15 (*H. L. J.*).

Corythucha juglandis (Fitch).

Me.— Eastport, 15 July '09 (*C. W. J.*); Lower Goose Id., Casco Bay, 24 July '08 (*W. M. W.*); Machias, 19 July '09 (*C. W. J.*); Orono, 22 May '14 (*H. M. P.*); Princeton, 12 July '09 (*C. W. J.*).

N. H.— Bretton Woods, 26 June '13 (*C. W. J.*); Glen House, 24 July '15 (*C. W. J.*); Mt. Washington, 2500 ft., 28 July '15 (*C. W. J.*).

Mass.— Chester, 28 May '12 (*C. W. J.*); Dover, 10 Sept. '08 (*A. P. M.*); Tuckernuck Id., 5 Aug. '13 (*J. A. C.*); Washington, 8 Aug. '12 (*C. W. J.*).

R. I.— Kingston, Aug. '05 (*J. B.*).

Conn.— Scotland, 15 Aug. '05 (*B. H. W.*); Stamford, 16 Aug. '12 (*W. E. B.*).

Galeatus peckhami (Ashmead).

Me.— Princeton, 12 July '09 (*C. W. J.*).

N. H.— Glen House, Osgood Trail, 20 July '15 (*C. W. J.*).

Leptobyrsa rhododendri (Horváth) (=*L. explanata* Heidemann).

Me.— Bar Harbor.

Mass.— Amherst, 21 June '05; Beach Bluff, 15 Aug. '14 (*H. M. P.*); Chester, 3 Aug. '11 (*C. W. J.*); Danvers, 3 July '14; Saugus, 5 Sept. '14 (*H. M. P.*).

Conn.— Greenwich, 3 July '13 (*W. E. B.*); New Haven, 30 June '15 (*W. E. B.*); Rockville, 28 June '09 (*H. W.*).

Gargaphia tiliae (Walsh).

N. H.— Hampton, 8 May '09 (*S. A. S.*); Intervale, 18 Aug. '08 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Chester, 5 Aug. '14 (*C. W. J.*).

Conn.— Pleasant Valley, Litchfield Co., 5 Sept. '15 (*G. P. E.*).

Gargaphia angulata Heidemann.

Mass.— Westfield, 10 July '05 (*C. W. J.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Hartford, 15 June '13 (*W. E. B.*); New Haven, 19 Aug. '13 (*L. B. R.*).

Leptostyla heidemanni Osborn and Drake.

Bull. Ohio Biol. Surv., 1916, vol. 2, no. 8, p. 238.

Mass.— Eastham, 27 June '04 (*C. W. J.*); Fall River, 22 July '05 (*J. A. C.*); Forest Hills, 8 Aug. '78 (*S. H.*); Newton, 16 June '14 (*J. R. T. B.*); Woods Hole, 25 July '05 (*J. A. C.*).

Physatocheila plexa (Say) Parshley.

R. I.— Kingston, 2 May '10 (*J. B.*); Providence (*C. A. D.*).

Physatocheila brevirostris Osborn and Drake.

Bull. Ohio Biol. Surv., 1916, vol. 2, no. 8, p. 243.

Mass.— Beach Bluff, 4 July '15 (*H. M. P.*).

Physatocheila variegata Parshley.

Psyche, 1916, vol. 23, p. 166.

Me.— Orono, 8 May '80 (*H. T. F.*).

Mass.— Wellesley, 19 May '91 (*A. P. M.*).

Conn.— Brookfield, 25 July '10 (*E. L. D.*); Portland, 15 May '14 (*B. H. W.*).

Melanorhopala clavata Stål.

Me.— Pownal, 15 July (*O. O. S.*).

Mass.— Amherst, 18 July '00; Beach Bluff, 21 June '15 (*H.*

M. P.); Fall River, 22 June '05 (*J. A. C.*); Newton, 16 June '14 (*J. R. T. B.*); Woods Hole, July (*T. H. M.*).

R. I.— Cumberland, 3 July '10 (*J. B.*).

Conn.— New Haven, 23 July '10 (*B. H. W.*).

Melanorhopala obscura Parshley.
Psyche, 1916, vol. 23, p. 167.

Mass.— Beach Bluff, 21 June '15 (*H. M. P.*); Nahant, 16 July '15 (*H. M. P.*); Wollaston, 28 June '96 (*F. H. S.*).

Hesperotingis antennata Parshley.
Psyche, 1917, vol. 24, p. 21.

Conn.— New Haven, 4 Sept. '11 (*C. E. O.*).

Hesperotingis antennata borealis Parshley.
Psyche, 1917, vol. 24, p. 24.

N. H.— Hampton, 15 Aug. '09 (*S. A. S.*).

Alveotingis grossocerata Osborn and Drake.
Bull. Ohio Biol. Surv., 1916, vol. 2, no. 8, p. 245.

Me.— Orono, 5 Aug. '13 (*H. O.*).

N. H.— Mt. Washington (*W. F. F.*).

ENICOCEPHALIDAE.

Systelloderes biceps (Say).
R. I.— Buttonwoods, 18 June '12 (*C. W. J.*).

PHYMATIDAE.

Phymata vicina Handlirsch.

Mass.— Amherst, 6 June '03; Cliftondale, 29 May '78 (*S. H.*); Gardner, 15 Aug. '16; Nantucket, 4 July '05 (*J. A. C.*).

R. I.— (*fide Van Duzee*).

Conn.— New Haven, 9 July '11 (*B. H. W.*).

Phymata erosa wolffi Stål.

Vt.— Middlebury, July '12; Winooski, 14 Aug. '01 (*C. A. D.*); Woodstock, 20 Aug '10 (*A. P. M.*).

Mass.— Amherst; Beach Bluff, 19 Aug. '13 (*H. M. P.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Forest Hills, 3 Oct. '16 (*C. A. F.*); Nantucket, 4 July '05 (*J. A. C.*); Provincetown, 1 Sept. '14 (*C. W. J.*); Woods Hole, 23 Aug. '14 (*W. M. M.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Kingston (*J. B.*); Providence (*C. A. D.*).

Conn.— Greenwich, 9 July '07 (*J. A. C.*); New Canaan, 14 Sept. '05 (*W. E. B.*); New Haven, 7 Sept. '05 (*E. B. W.*); S. Meriden, 3 Aug. '14 (*H. L. J.*).

REDUVIIDAE.

Emesinae.

Tribe Ploiariolini.

Ploiariola errabunda (Say).

N. H.— (*Harris Coll.*).

Mass.— Amherst, 5 June '14 (*G. C. C.*); Beverly, 15 July '09 (*C. W. J.*).

Ploiariola tuberculata Banks.

Me.— Monmouth, 27 June '12 (*C. A. F.*); Paris, 4 July '16 (*C. A. F.*).

Mass.— Fall River, 22 May '11 (*N. S. E.*); Sherborn, 30 May '16 (*C. A. F.*).

Ploiariola hirtipes Banks.

Me.— Orono (*H. T. F.*).

Vt.— Brattleboro, 15 July '08 (*C. W. J.*).

Mass.— Nantucket, 21 Aug. '11 (*H. T. F.*).

R. I.— Kingston, 19 Aug. '05 (*J. B.*).

Tribe EMESINI.

Emesa brevipennis (Say) (= *E. longipes* DeGeer).

MASS.— Amherst; Boston, 23 Sept. '09 (*C. W. J.*); Cambridge, 22 Sept. '00 (*C. O.*); Cohasset, 10 Sept. '05 (*O. B.*); Concord, 14 Oct. '10 (*C. W. J.*); Saugus, 22 Aug. '14 (*H. M. P.*); Wellesley, Aug. '98 (*A. P. M.*); Wollaston, 1 Oct. '82 (*F. H. S.*).

R. I.— Kingston, Sept. '03 (*J. B.*).

CONN.— Farmington, 17 Aug. '14 (*W. M.*); Manchester, 14 Sept. '10 (*B. H. W.*); New Canaan, 21 Sept. '09 (*A. I. B.*); New Haven, 27 Aug. '11 (*M. P. Z.*).

Barce annulipes Stål.

N. H.— Jackson, 22 Sept. '07 (*O. B.*).

MASS.— Andover, 9 Sept. '15 (*F. X. W.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Framingham, 10 July '05 (*C. A. F.*); Malden.

CONN.— New Haven, 26 Feb. '11 (*A. B. C.*).

Barce uhleri brunnea Banks.

MASS.— Brookline, 24 Sept. '13 (*C. W. J.*); Forest Hills, 30 March '15 (*F. X. W.*), 17 April '15 (*C. T. B.*), 31 May '15 (*F. X. W.*); Truro, 4 Sept. '04 (*A. P. M.*); Tyngsboro, 6 Mar. '98 (*F. B.*).

Barce fraterna (Say).

MASS.— Cambridge, Sept. (*fide Banks*); Framingham, 26 Aug. '06 (*C. A. F.*); Milton, 17 June '27 (*Harris Coll.*); Salem (*Harris Coll.*).

STENOPODINAE.

Pygolampis sericea Stål.

N. H.— Durham (*C. M. W. & W. F. F.*).

Pygolampis pectoralis (Say).

ME.— Manchester (*fide Stover*).

N. H.— Mt. Washington, summit (*fide Slosson*).

Mass.— Amherst, 28 May '92; Framingham, 10 July '05 (*C. A. F.*); Milton, 15 May '26 (*Harris Coll.*); Tyngsboro (*F. B.*).

Reduviinae.

Reduvius personatus (Linné).

Me.— Brunswick (*fide Stover*); Gorham, 10 June '13 (*W. B. H.*); Newbury Neck, near Surry, 22 June '03 (*F. A. E.*); Orono, 21 July '12; Pownal (*O. O. S.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mountain View, Aug. '15 (*A. M. W.*).

Vt.— Middlebury, July '12.

Mass.— Amherst; Cohasset, 20 June '08 (*O. B.*); Danvers, 1 June '08; Forest Hills, 11 June '14 (*H. M. P.*); Framingham, 9 July '07 (*C. A. F.*); Tyngsboro (*F. B.*); W. Brookfield, 12 July.

Conn.— Litchfield, June '09 (*L. B. W.*).

Piratinae.

Melanolestes picipes (Herrich-Schaeffer).

N. H.— Webster, July '00.

Mass.— Framingham, 16 April '05 (*C. A. F.*); Sherborn, 15 May '14 (*C. A. F.*); Wellesley, 8 Aug. '07 (*A. P. M.*).

R. I.— Kingston, 26 Sept. '07 (*J. B.*); Providence, 6 Oct. (*C. A. D.*).

Conn.— Durham, 16 Sept. '10 (*W. E. B.*); Lyme, 20 Aug. '10 (*A. B. C.*); Middlebury, 26 May '11 (*W. E. B.*); S. Meriden, 27 Sept. '14 (*H. L. J.*); W. Haven, 11 May '05 (*B. H. W.*).

Melanolestes picipes abdominalis (Herrich-Schaeffer).

Mass.— Framingham (*C. A. F.*).

R. I.— Kingston, 13 May '05, 18 Oct. '05 (*J. B.*); Providence (*C. A. D.*).

Conn.— Canaan, 4 May '12 (*D. J. C.*); New Canaan, 22 Sept. '10 (*W. E. B.*); New Haven, 25 May '11 (*A. B. C.*); Salisbury, 27 Aug. '04 (*W. E. B.*); Torrington (*G. H. H.*).

APIOMERINAE.

Apiomerus crassipes (Fabricius).

CONN.— New Haven, 20 June '02 (*E. J. S. M.*); Woodbury, 19 July '13 (*W. E. B.*).

HARPACTORINAE.

Tribe ZELINI.

Zelus exsanguis Stål.

ME.— Manchester (*O. O. S.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, summit (*fide Slosson*).

VT.— Bennington, 22 June '14 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

MASS.— Amherst, 1 June '98; Chester, 27 May '12 (*C. W. J.*); Edgartown, 28 June (*C. W. J.*); Forest Hills, 15 June '16 (*A. M. W.*); Woods Hole, 9 Aug. '14 (*W. S. A.*); Worcester, 6 July '15 (*F. X. W.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, July '14 (*J. B.*); Tiverton, 12 July '16 (*C. W. J.*).

CONN.— Portland, 5 June '15 (*M. P. Z.*); Wallingford, 2 July '12 (*D. J. C.*).

Zelus socius Uhler.

ME.— Monmouth, 18 July '14 (*C. A. F.*); Northeast Harbor, 27 July '11 (*C. S. M.*).

MASS.— Hopkinton, 14 June '14 (*C. A. F.*).

Zelus audax Banks.

MASS.— Andover; Tyngsboro (*F. B.*).

CONN.— Portland, 10 Aug. '13 (*B. H. W.*).

Rhynocoris ventralis (Say).

ME.— Monmouth, 26 June '06 (*C. A. F.*).

MASS.— Framingham, 12 June '04 (*C. A. F.*).

Pselliopus cinctus (Fabricius).

MASS.— Amherst; Auburndale, 25 Sept. '11 (*C. W. J.*); Bedford, 12 May (*C. W. J.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Forest Hills, 16 May '16 (*A. M. W.*); Framingham, 4 Sept. '04 (*C. A. F.*).

R. I.— Kingston, 4 July '14 (*J. B.*); Providence (*C. A. D.*).

CONN.— Lyme, 14 May '11 (*A. B. C.*); New Canaan, 20 Sept. '12 (*H. B. K.*); New Haven, 9 June '14 (*Q. S. L.*); Poquonock, 27 June '05 (*B. H. W.*); Portland, 15 Aug. '13 (*B. H. W.*); S. Meriden, 31 May '14 (*H. L. J.*); Stonington, 1 July '14 (*I. W. D.*).

Fitchia aptera Stål.

ME.— Manchester; Monmouth; Orono, 31 May '14 (*H. M. P.*).

N. H.— Hampton, 27 April '98 (*S. A. S.*); Hanover (*C. M. W.*).

VT.— Norwich (*C. M. W.*).

MASS.— Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 27 March '15 (*F. X. W.*); Framingham (*C. A. F.*); Horseneck Beach, 30 July '13 (*C. W. J.*); S. Sudbury, 5 Nov. '05 (*O. B.*); Tyngsboro, 16 Oct. (*F. B.*).

CONN.— New Haven, 21 April '11 (*A. B. C.*); Orange, 21 May '11 (*B. H. W.*); S. Meriden, 3 Oct. '14 (*H. L. J.*).

Tribe HARPACTORINI.

Acholla multispinosa (DeGeer).

ME.— (*fide Stover*).

N. H.— Alton (*F. B.*); Durham (*C. M. W. & W. F. F.*).

MASS.— Amherst, 14 Aug. '00; Cambridge, 27 Aug. '07 (*A. P. M.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Fall River; Forest Hills, 16 Sept. '14 (*H. M. P.*); Sherborn, 31 Aug. '14 (*C. A. F.*).

R. I.— Kingston, Oct. '04 (*J. B.*).

CONN.— Hartford, 22 Oct. '06 (*B. H. W.*); Manchester, 21 Sept. '11 (*B. H. W.*); New Canaan, 2 Oct. '07 (*W. E. B.*); Wallingford, 14 Aug. '10 (*D. J. C.*); Westville, 7 Sept. '05 (*B. H. W.*); Windsor Locks, 1 Sept. '03 (*W. E. B.*).

Sinea diadema (Fabricius).

Me.— Fryeburg, 20 Aug. '12 (*A. P. M.*); Orono, 3 Sept. '13; Westbrook, 13 Sept. '00 (*O. O. S.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Holderness, 17 Aug. '99 (*A. P. M.*).

Vt.— Hartland, 9 Aug. '13 (*P. W. W.*); Newport, 12 July '91 (*A. P. M.*).

Mass.— Amherst, 2 Aug. '05; Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Forest Hills, 17 Sept. '14 (*H. M. P*); Nantucket, 20 Sept. '15 (*W. S. A.*); N. Adams, 13 Aug. '07 (*C. W. J.*); Peru, 26 Aug. '04 (*J. B.*); West Chop, 22 July '93 (*A. P. M.*); West Newbury; Woods Hole, 9 Aug. '15 (*W. S. A.*).

R. I.— Kingston, 2 Aug. '05 (*J. B.*); Providence, 15 Sept. (*C. A. D.*).

Conn.— Canaan, 18 Aug. '94 (*A. P. M.*); Colebrook, 1 Sept. '11 (*W. M. W.*); New Canaan, 11 Sept. '14 (*M. P. Z.*); Meriden, 28 July '09 (*A. I. B.*); Stafford, 24 Aug. '05 (*W. E. B.*); Torrington (*R. H.*).

HEBRIDAE.

Hebrus burmeisteri Lethierry and Severin.

Mass.— Edgartown, 28 June '12 (*C. W. J.*); Framingham, 22 Oct. '16 (*C. A. F.*); Sherborn, 6 Jan. '17 (*C. A. F.*); Tyngsboro, April '91 (*F. B.*).

Conn.— New Haven, 25 March '11 (*A. B. C.*).

MESOVELIIDAE.

Mesovelia mulsanti White.

Mass.— Forest Hills, 17 June '14, 8 Oct. '14 (*H. M. P.*); Saugus, 22 Aug. '15 (*H. M. P.*).

NABIDAE.

PROSTEMMINAE.

Pagasa fusca (Stein).

ME.— Orono; Paris, 10 July '15 (*C. A. F.*).

N. H.— Mt. Washington, summit (*fide Slosson*).

VT.— Stratton, 7 July '13 (*P. W. W.*).

MASS.— Boston, 30 Aug. '14 (*F. X. W.*); Framingham, 10 Oct. '07 (*C. A. F.*); Milton, 17 June '27 (*Harris Coll.*).

R. I.— Portsmouth, 23 July '08 (*N. S. E.*).

CONN.— Lyme, 20 Aug. '10 (*A. B. C.*); New Canaan, 23 Sept. '10, winged form (*W. E. B.*).

NABINAE.

Tribe NABINI.

Nabis subcoleoptratus Kirby.

ME.— Belfast; Ft. Kent, 17 Aug. '10 (*C. W. J.*); Orono, 11 July '05; Pemaquid Pt., Aug. '06 (*H. W. F.*); Southwest Harbor, 25 July '10 (*H. T. F.*).

N. H.— Hanover, 3 July '08 (*C. W. J.*); N. Conway, 30 July '91 (*A. P. M.*); Webster (*W. F. F.*).

VT.— Newport, 12 July '91 (*A. P. M.*); St. Johnsbury, 23 July '91 (*A. P. M.*).

MASS.— Amherst, 2 July '94; Framingham, 10 Oct. '07 (*C. A. F.*); Winchendon, 1 July '92 (*A. P. M.*).

CONN.— Litchfield, 29 June '13 (*L. B. W.*); Salisbury, 29 Aug. '04 (*W. E. B.*).

Nabis sordidus Reuter.

MASS.— Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Brookline, 6 Sept. (*C. W. J.*); Woods Hole, 10 July '05 (*J. A. C.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*).

Nabis annulatus Reuter.

MASS.— Auburndale, 16 Aug. (*C. W. J.*); Blue Hills, 14 Aug.

'78 (*S. H.*); Boston, Chestnut Hill, 24 Sept. '14 (*C. W. J.*); Sharon, 25 Aug. '13; Weston, 23 July '11; Woods Hole (*fide T. H. M.*).

R. I.— Kingston, 18 Aug. '07 (*J. B.*).

Conn.— Portland, 7 Aug. '13 (*B. H. W.*).

Nabis propinquus Reuter.

Me.— Liberty, 17 July '12 (*J. A. C.*).

Mass.— Beach Bluff, 13 Aug. '14 (*H. M. P.*); Fanueil, 12 Aug. '04 (*A. P. M.*); Tisbury, 31 July '11 (*J. A. C.*).

Nabis limbatus Dahlbom.

Me.— Bowlin Pond, 31 July '10 (*J. A. C.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Machias, 26 July '06 (*C. W. J.*); Princeton, 12 July '09 (*C. W. J.*); Township 2, Range 7, Penobscot Co., 2 Aug. '10 (*J. A. C.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Crawfords, 28 Oct. '16 (*H. M. P.*); Mt. Washington, Tuckerman's Ravine, 6 Sept. '95 (*A. P. M.*).

Mass.— Mt. Greylock, 3500 ft., 17 Aug. '94 (*A. P. M.*).

Nabis flavomarginatus Scholz.

Me.— Eastport, 15 July '09 (*C. W. J.*); Machias, 17 July '09 (*C. W. J.*).

Nabis ferus (Linné).

Me.— Bowlin Pond, 31 July '10 (*J. A. C.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Naples, 1 July '13 (*C. W. J.*); Orono, 17 April '12 (*H. M. P.*).

Vt.— Mt. Ascutney, 23 July '12 (*C. W. J.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Glen House, 20 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Amherst; Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Forest Hills, 12 May '16 (*H. M. P.*); Provincetown, 8 Sept. '90 (*A. P. M.*); Tisbury, 6 Aug. '11 (*J. A. C.*); Tuckernuck Id., 5 Aug. '13 (*J. A. C.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*); Kingston, 30 April '05, 17 July '05 (*J. B.*); Providence, 30 March (*C. A. D.*).

CONN.— Cheshire, 8 July '04 (*H. L. V.*); Hartford, 7 May '14 (*W. M.*), 19 Oct. '04 (*W. E. B.*); Lyme, 4 Oct. '10 (*A. B. C.*); New Haven, 31 Oct. '03 (*E. J. S. M.*); N. Windham, 14 July '94 (*A. P. M.*); Windsor, 18 July '04 (*B. H. W.*).

Nabis roseipennis Reuter.

ME.— Orono, 7 May '14, 5 Oct. '13 (*H. M. P.*).

N. H.— Jackson, 22 Sept. '07; Mt. Washington, summit (*fide Slosson*).

MASS.— Amherst, 28 May '92; Beach Bluff, 31 Aug. '14 (*H. M. P.*); Blue Hills, 22 May '15 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Chester, 27 May '12 (*C. W. J.*); Forest Hills, 10 April '16 (*A. M. W.*); N. Adams, 18 June '06 (*C. W. J.*); Peru, 29 Aug. '04 (*J. B.*); Winchendon, 2 July '92 (*A. P. M.*).

R. I.— Kingston, 30 April '05, 17 July '05 (*J. B.*); Providence, 30 March (*C. A. D.*).

CONN.— Danbury, 15 June '09 (*C. W. J.*); Hartford, 17 July '05 (*H. W. W.*); Litchfield, 9 March '13 (*L. B. W.*); S. Meriden, 6 May '15 (*H. L. J.*); Winnipauk, 16 June '09 (*C. W. J.*).

Nabis rufusculus Reuter.

ME.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Liberty, 13 Sept. '13 (*J. A. C.*); Orono, 19 April '14 (*H. M. P.*); Unity (*W. C. W.*).

N. H.— Bretton Woods, 26 June '13 (*C. W. J.*); Fabyans (*W. F. F.*); Hanover, 8 July '08 (*C. W. J.*); Jackson, 22 Sept. '07 (*C. W. J.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*); N. Conway, 18 April '15.

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Gorham (*J. H. E.*); Manchester, 8 June '10 (*C. W. J.*); Montpelier, 25 June '06 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

MASS.— Beverly, 24 April '92 (*A. P. M.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Forest Hills, 1 June '15 (*H. M. P.*); Franklin, 26 May '16 (*H. M. P.*); Peru, 26 Aug. '04 (*J. B.*); Provincetown, 8 Sept. '90 (*A. P. M.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, 12 Sept. '15 (*W. S. A.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Litchfield, 7 May '15 (*L. B. W.*); S. Kent, 20 Aug. '94 (*A. P. M.*).

Nabis brevis Scholz.

Conn.— Cromwell, 13 Dec. '10, on nursery stock imported from England (*A. B. C.*).

Metatropiphorus belfragei Reuter.

Mass.— Manomet, 5 Aug. '12 (*W. S. B.*); Tyngsboro, 17 July '92 (*F. B.*).

CIMICIDAE.

Cimicinae.

Cimex lectularius Linné.

Me.— Orono.

Mass.— Amherst, 12 March '98; Beach Bluff, 22 June '13 (*H. M. P.*); Framingham, 26 June '15 (*C. A. F.*); Woods Hole, July (*T. H. M.*).

R. I.— Block Id., 25 July '10; Kingston, Aug. '08 (*J. B.*).

Conn.— North Haven, 16 Oct. '08 (*B. H. W.*); Hartford, 13 Aug. '91 (*A. P. M.*).

Cimex pilosellus Horváth.

Mass.— East Wareham, 14 June '15 (*O. Bangs*).

Oeciacus vicarius Horváth.

Me.— Franklin, 18 June '16.

Mass.— East Douglas, 7 Aug. '96.

Conn.— Mt. Carmel, 29 May '03 (*L. L. D.*).

ANTHOCORIDAE.

Lyctocorinae.

Xylocoris cursitans (Fallén).[1]

N. H.— North Conway, 18 April '15.

Mass.— Forest Hills, 23 Feb. '15, 26 Oct. '15 (*H. M. P.*); Lynn, 18 Aug. '15 (*H. M. P.*).

Conn.— New Haven, 24 Nov. '10 (*A. B. C.*).

Anthocorinae.

Macrotracheliella nigra Parshley.

Ent. News, 1917, vol. 28, p. 37.

Mass.— Chilmark, 14 Aug. '11 (*J. A. C.*).

R. I.— Tiverton, 13 Aug. '15 (*N. S. E.*).

Anthocoris borealis Dallas (? = *A. musculus* Say).

Me.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Holden, 28 June '00 (*F. A. E.*); Mt. Desert (*H. T. F.*); Orono, 30 April '12 (*H. M. P.*); Paris, 15 July '14 (*C. A. F.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Mt. Lafayette, summit, 22 Sept. '95 (*F. B.*).

Mass.— Peru, 28 Aug. '04 (*J. B.*).

R. I.— Kingston, 7 July '10 (*J. B.*).

Triphleps insidiosa (Say).

Me.— Newbury Neck, near Surrey, 22 June '03 (*F. A. E.*); Orono, 30 Sept. '82 (*H. T. F.*); Pownal (*O. O. S.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 3 Oct. '16 (*H. M. P.*); Intervale, 12 Aug. (*G. M. A.*); Mt. Washington, summit (*fide Slosson*).

Vt.— St. Johnsbury, 23 July '91 (*A. P. M.*); Woodstock, 11 Aug. '98 (*A. P. M.*).

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[1] Sometimes determined as *X. galactinus* (Fieber) or *X. sordidus* (Reuter).

Mass.— Beverly, 22 Aug.; Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Forest Hills, 8 Oct. '14 (*H. M. P.*); Manomet, 13 Aug. '12 (*W. S. B.*); Nantucket, 17 Aug. '11 (*H. T. F.*); Westfield, 7 Aug. '11 (*C. W. J.*); Woods Hole (*fide T. H. M.*).

R. I.— Kingston, 17 July '05 (*J. B.*).

Conn.— Branford, 27 June '04 (*H. L. V.*); Brookfield, 27 July '10 (*E. L. D.*); Glastonbury, 13 July '13 (*L. B. R.*); New Haven, 16 Oct. '03 (*H. L. V.*); Rowayton, 5 Aug. '09 (*C. W. J.*).

TERMATOPHYLIDAE.

Hesperophylum heidemanni Reuter and Poppius.

N. H.— Mt. Washington (*fide Reuter and Poppius*).

MIRIDAE.

Mirinae.

Tribe Mirini.

Collaria meilleuri Provancher.

Me.— Ft. Kent, 17 Aug. '10 (*C. W. J.*); Machias, 26 July '06 (*C. W. J.*); Monmouth, 16 July '14 (*C. A. F.*); Orono, 10 Aug. '06; Township 2, Range 7, Penobscot Co., 2 Aug. '10 (*J. A. C.*); S. Harpswell, 27 July '08 (*J. A. C.*).

N. H.— Hanover, 8 July '08 (*C. W. J.*); Holderness, 2 Aug. '99 (*A. P. M.*); N. Conway, 30 July '91 (*A. P. M.*); Squam Lake, 7 Aug. '07 (*C. W. J.*).

Vt.— Mt. Mansfield, 21 July '91 (*A. P. M.*); Newport, 12 July '91 (*A. P. M.*).

Mass.— Brookline, 26 June '77 (*S. H.*); Wellesley, 1 Aug. '94 (*A. P. M.*); Tyngsboro (*F. B.*); Woods Hole (*fide T. H. M.*).

Conn.— Colebrook, 21 July '05 (*H. L. V.*); S. Meriden, 16 July '15 (*H. L. J.*).

Collaria oculata (Reuter).

Me.— Durham (*O. O. S.*).

N. H.— Holderness, 5 Aug. '99 (*A. P. M.*).

Mass.— Amherst, 30 July '97; Dedham, 17 June '92 (*A. P. M.*); Provincetown, 28 July '91 (*A. P. M.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

Conn.— Cheshire, 8 July '04 (*H. L. V.*); New Haven, 1 June '11 (*B. H. W.*).

Miris dolabratus (Linné).

Me.— Eastport, 15 July '09 (*C. W. J.*); Orono, 22 May '14 (*H. M. P.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Glen House, 15 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, base, 7 July '14 (*C. W. J.*); Alpine Garden, 4 July '14 (*C. W. J.*); summit (*fide Slosson*).

Vt.— Bennington, 18 June '15 (*C. W. J.*); St. Albans, 19 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Amherst; Edgartown, 28 June '12 (*C. W. J.*); Forest Hills, 17 June '14 (*H. M. P.*); Nantucket, 4 July '05 (*J. A. C.*); N. Adams, 18 June '06 (*C. W. J.*); Provincetown, 29 June '91 (*A. P. M.*); Woods Hole, 2 July '05 (*J. A. C.*).

R. I.— Block Id., 25 July '10; Buttonwoods, 15 June '12 (*C. W. J.*); Kingston, 17 June '05 (*J. B.*).

Conn.— Brookvale, 30 May '02 (*W. E. B.*); Farmington, 14 June '14 (*W. M.*); Greenwich, 9 July '07 (*J. A. C.*); S. Meriden, 6 July '14 (*H. L. J.*).

Stenodema trispinosum Reuter.

Me.— Bowlin Pond, 31 July '10 (*J. A. C.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono, 22 May '14 (*H. M. P.*); The Forks, 16 June (*O. O. S.*); Wales, 16 July '15 (*C. A. F.*).

Mass.— Auburndale, 22 May (*C. W. J.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Tisbury, 25 July '11 (*J. A. C.*); Woods Hole, July (*T. H. M.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*); Cumberland, 3 July '10 (*J. B.*); Kingston, 17 June '05 (*J. B.*).

CONN.— Darien, 10 June '12 (*C. W. J.*); New Haven, 10 May '11 (*A. B. C.*), 31 Oct. '03 (*H. L. V.*); Putnam, 12 July '05 (*H. L. V.*); S. Meriden, 18 May '15 (*H. L. J.*).

Stenodema vicinum (Provancher).

ME.— Capens, 11 July '07 (*C. W. J.*); Ft. Kent, 17 July '05 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Orono, 11 May '12 (*H. M. P.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Crawfords, 28 Oct. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Holderness, 2 Aug. '90 (*A. P. M.*); Mt. Washington, Glen to Halfway House, 8 July '91 (*A. P. M.*); summit (*fide Slosson*).

VT.— Jay Peak, summit, 14 July '91 (*A. P. M.*).

MASS.— Amherst, 7 Aug. '91; Chester, 8 Aug. '12 (*C. W. J.*); Fall River, 22 July '05 (*J. A. C.*); Forest Hills, 20 May '15 (*S. L. M.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Mt. Greylock (*C. W. J.*); Peru, 26 Aug. '04 (*J. B.*); Springfield, 13 July '05 (*C. W. J.*).

CONN.— Branford, 28 July '05 (*H. L. V.*); Brookfield, 27 July '10 (*E. L. D.*); Canterbury, 14 Aug. '05 (*B. H. W.*); New Haven, 6 July '04 (*H. L. V.*); Winnipauk, 4 Aug. '08 (*C. W. J.*).

Mesomiris curtulus Reuter.

MASS.— Chilmark, 14 Aug. '11 (*J. A. C.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Martha's Vineyard, 11 Sept. '15 (*W. S. A.*).

Trigonotylus ruficornis (Fallén).

ME.— Bowlin Pond, 31 July '10 (*J. A. C.*); Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Orono (*H. T. F.*).

N. H.— Fabyans (*W. F. F.*); Glen House, 24 July '15 (*C. W. J.*); Hanover, 26 June '91; Mt. Washington, 3000 ft., 28 July '15 (*C. W. J.*); summit (*fide Slosson*).

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Middlebury, July '12.

MASS.— Beach Bluff, 27 Aug. '14 (*H. M. P.*); Cohasset, 21 Sept. '14 (*H. M. P.*); Edgartown, 29 June '12 (*C. W. J.*); Framingham, 28 July '14 (*C. A. F.*); Nantucket, 4 July '04 (*J. A. C.*); Woods Hole (*fide T. H. M.*).

CONN.— Branford, 21 June '04 (*H. L. V.*); Colebrook, 20 July '05 (*W. E. B.*).

Trigonotylus brevipes Jakovlev.

CONN.— East River, 30 July '10 (*C. R. E.*).

Trigonotylus tarsalis (Reuter).

MASS.— Beach Bluff, 22 June '14 (*H. M. P.*); Chelsea; Nantasket, 8 Aug. '06.

CONN.— Colebrook, 20 July '05 (*W. E. B.*).

Trigonotylus uhleri (Reuter).

N. H.— Durham (*C. M. W. & W. F. F.*).

MASS.— Cohasset, 21 Sept. '14 (*H. M. P.*); Edgartown, 29 June '12 (*C. W. J.*); Nantucket, 19 Aug. '09 (*J. A. C.*).

CONN.— Stratford, 29 June '08 (*W. E. B.*); Woodmont, 9 July '04 (*P. L. B.*).

Teratocoris discolor Uhler.

MASS.— Beach Bluff, 21 June '15, 8 Sept. '15 (*H. M. P.*).

Tribe HORISTINI.

Platytylellus insitivus (Say).

ME.— Paris, 7 July '15 (*C. A. F.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, summit (*fide Slosson*).

VT.— Ascutney Mt., 23 July '12 (*C. W. J.*).

MASS.— Amherst; Milton, July '26 (*Harris Coll.*); Tisbury, 21 July '11 (*J. A. C.*).

R. I.— Kingston, 8 Aug. '07 (*J. B.*); Newport Co., 16 July '12 (*N. S. E.*).

CONN.— Lyme, 20 Aug. '10 (*B. H. W.*).

Platytylellus confraternus (Uhler).

MASS.— Amherst, 8 July '11; Milton, 15 Sept. '27 (*Harris Coll.*); Saugus, 21 June '14 (*F. W. D.*).

Conn.— Portland, 14 July '14 (*M. P. Z.*); S. Meriden, 9 July '15 (*H. L. J.*).

Platytylellus nigricollis (Reuter).

Me.— W. Brooksville, 30 Aug. '99 (*F. A. E.*).

Mass.— Beach Bluff, 15 Aug. '14 (*H. M. P.*); Framingham, 22 Aug. '14 (*C. A. F.*).

Platytylellus insignis (Say).

Me.— Mt. Kineo (*fide Stover*); Orono, 15 July '13; Paris.

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Mt. Washington, summit (*fide Slosson*); Webster (*W. F. F.*).

Vt.— Newport, 12 July '91 (*A. P. M.*); Norwich (*C. M. W.*).

Mass.— Danvers, 3 Aug. '15 (*H. M. P.*); West Chop, 4 July '93 (*A. P. M.*); Winchendon, 1 July '92 (*A. P. M.*).

R. I.— Cumberland, 3 July '10 (*J. B.*); Kingston (*J. B.*).

Conn.— Cheshire, 8 July '04 (*H. L. V.*); Colebrook, 21 July '05 (*H. L. V.*).

Tribe CAPSINI.

Division *Myrmecoraria.*

Pithanus maerkeli (Herrich-Schaeffer).

Me.— Eastport, 14 July '09 (*C. W. J.*); Mistake Id., 9 Aug. '07 (*J. A. C.*); Roque Bluff, 15 Aug. '07 (*J. A. C.*).

Division *Phytocoraria.*

Neurocolpus nubilus (Say).

Me.— Orono.

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover, 3 July '15 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Amherst; Chester, 8 Aug. '12 (*C. W. J.*); Cohasset, 8 Sept. (*O. B.*); Forest Hills, 17 June '14, 4 Oct. '15 (*H. M. P.*); Mt. Tom, 14 July '05 (*C. W. J.*); Rockport, 15 July '04 (*C. W. J.*); Williamsburg, 7 Aug. '11 (*C. W. J.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

R. I.— Kingston, 10 Aug. '07 (*J. B.*); Providence, 30 June (*C. A. D.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Litchfield, 21 Aug. '15 (*L. B. W.*); New Haven, 6 July '04 (*H. L. V.*); Portland, 14 Aug. '13 (*B. H. W.*); S. Meriden, 13 July '15 (*H. L. J.*); Woodbury, 14 July '13 (*W. E. B.*).

Phytocoris lasiomerus Reuter.

Me.— Orono, 30 July; Monmouth, 16 July '14 (*C. A. F.*); Staceyville, Aug. '02 (*H. G. B.*).

N. H.— Hanover, 6 July '08 (*C. W. J.*); Holderness, 1 Aug. '99 (*A. P. M.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*).

Mass.— Peru, 29 Aug. '04 (*J. B.*).

Phytocoris pallidicornis Reuter.

Me.— Orono, 12 Sept. '13 (*H. M. P.*); Liberty, 6 Sept. '13 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*).

Mass.— Beach Bluff, 8 Sept. '15 (*H. M. P.*); Forest Hills, 17 Sept. '14 (*H. M. P.*); Nantucket, 9 Aug. '09 (*J. A. C.*).

Phytocoris minututus Reuter.

Mass.— Forest Hills, 16 Sept. '14 (*H. M. P.*).

Phytocoris antennalis Reuter.

Mass.— Ipswich, July '09 (*E. P. V. D.*) (*fide Van Duzee*).

Phytocoris annulicornis (Reuter).

Mass.— Beach Bluff, 27 Aug. '14 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*).

Phytocoris fenestratus Reuter.

Conn.— Salisbury, 27 Aug. '04 (*W. E. B.*).

Phytocoris inops Uhler.

Mass.— Blue Hills, 15 Sept. '14 (*H. M. P.*).

Phytocoris eximius Reuter.

Me.— Ft. Kent, 17 Aug. '10 (*C. W. J.*); Orono, 30 June; Waldoboro.

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*).

Mass.— Saugus, 7 Sept. '14 (*H. M. P.*); West Chop, 5 Aug. '93 (*A. P. M.*).

R. I.— Kingston, 31 Aug. '07 (*J. B.*).

Conn.— Branford, 15 July '04 (*H. W. W.*); East River, 3 Aug. '10 (*C. R. E.*); Hartford, 12 Sept. '07 (*W. E. B.*); Litchfield, 27 June '14 (*L. B. W.*); New Haven, 27 June '04 (*W. E. B.*); Portland, 14 Aug. '13 (*B. H. W.*).

Phytocoris infuscatus Reuter.

Mass.— Fall River, 9 July '05 (*J. A. C.*).

Conn.— East River, July '10 (*C. R. E.*).

Phytocoris puella Reuter.

Mass.— Auburndale, 9 Aug. (*C. W. J.*); Saugus, 7 Sept. '14 (*H. M. P.*).

R. I.— Kingston, 26 Aug. '07; Sept. '07 (*J. B.*).

Conn.— East River, Aug. '10 (*C. R. E.*).

Phytocoris puella confluens Reuter.

Conn.— East River, Aug. '10 (*C. R. E.*); New Haven, 9 July '12.

Phytocoris tibialis Reuter.

Vt.— Brattleboro, 13 June '08 (*C. W. J.*).

Mass.— Beach Bluff, 31 Aug. '14 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Chester, 15 June '12 (*C. W. J.*); Williamsburg, 2 Aug. '11 (*C. W. J.*).

R. I.— Kingston, 10 Aug. '07 (*J. B.*).

Conn.— Branford, 20 July '05 (*H. W. W.*); East River, Aug. '10 (*C. R. E.*).

Adelphocoris rapidus (Say).

Me.— Ft. Kent, 10 Aug. '10 (*C. W. J.*); Orono, 25 Sept. '13 (*H. M. P.*); Pownal (*O. O. S.*).

N. H.— Claremont (*R. P. D.*) (*fide Torre Bueno*); Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Glen House, 7 July '14 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Bennington, 22 June '15 (*C. W. J.*).

MASS.— Amherst; Beach Bluff, 27 June '15 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Martha's Vineyard, 11 Sept. '15 (*W. S. A.*); Peru, 26 Aug. '04 (*J. B.*); Woods Hole, 5 Sept. (*W. S. A.*).

R. I.— Cumberland, 5 July '10 (*J. B.*); Kingston, 15 July '05 (*J. B.*).

CONN.— Chapinville, 27 Aug. '04 (*W. E. B.*); Farmington, 14 June '14 (*W. M.*); New Haven, 24 June '02 (*E. J. S. M.*); Rowayton, 5 Aug. '08 (*C. W. J.*); Scotland, 27 July '04 (*B. H. W.*); Stafford, 24 Aug. '05 (*W. E. B.*); Yalesville, 19 Oct. '03 (*H. L. V.*).

Stenotus binotatus (Fabricius).

MASS.— Amherst; Beach Bluff, 22 June '14 (*H. M. P.*); Forest Hills, 17 June '14 (*H. M. P.*); Newton, 16 June '14 (*J. R. T. B.*).

Garganus fusiformis (Say).

MASS.— Amherst, 1 Sept. '99.

CONN.— Branford, 29 July '05 (*W. E. B.*).

Division *Dichrooscytaria.*

Paracalocoris scrupeus (Say) McAtee.

Ann. Ent. Soc. Amer., 1916, vol. 9, p. 370.

MASS.— Auburndale, 4 July '07 (*C. W. J.*).

CONN.— New Canaan, 24 June '15 (*M. P. Z.*); Unionville, 11 June '14 (*W. M.*).

Paracalocoris scrupeus triops McAtee.

Ann. Ent. Soc. Amer., 1916, vol. 9, p. 371.

VT.— Bennington, 21 June '15 (*C. W. J.*).

MASS.— Fall River, 27 June '15 (*N. S. E.*).

Paracalocoris scrupeus par McAtee.
Ann. Ent. Soc. Amer., 1916, vol. 9, p. 373.

VT.— Bennington, 24 June '15 (*C. W. J.*).

Paracalocoris scrupeus bidens McAtee.
Ann. Ent. Soc. Amer., 1916, vol. 9, p. 374.

VT.— Bennington, 19–24 June '15 (*C. W. J.*).

MASS.— Auburndale, 4 July '07 (*C. W. J.*); Forest Hills, 17 June '14 (*H. M. P.*).

R. I.— Tiverton, 12 July '16 (*C. W. J.*).

CONN.— Farmington, 19 June '14 (*W. M.*); Wallingford, 14 June '11 (*J. K. L.*).

Paracalocoris scrupeus nubilus McAtee.
Ann. Ent. Soc. Amer., 1916, vol. 9, p. 375.

VT.— Bennington, 22 June '15 (*C. W. J.*) (*atypical*).

Paracalocoris limbus McAtee.
Ann. Ent. Soc. Amer., 1916, vol. 9, p. 380.

MASS.— Brookline, 4 July (*C. W. J.*); Mt. Tom, 14 July '05 (*C. W. J.*).

Paracalocoris colon amiculus McAtee.
Ann. Ent. Soc. Amer., 1916, vol. 9, p. 384.

MASS.— Boston (vicinity).

Calocoris norvegicus (Gmelin).

ME.— Eastport, 15 July '09 (*C. W. J.*); Orono, 25 July '82 (*H. T. F.*); Orr's Id., 15 July '09 (*C. W. J.*).

MASS.— Beverly (*E. B.*); Cohasset, 25 June (*O. B.*); Eastham, 27 June '09 (*C. W. J.*); Forest Hills, 17 June '14 (*H. M. P.*); Hyannisport, 4 July '04 (*J. A. C.*); Nantucket, 4 July '04 (*J. A. C.*); Rockport, 15 July '04 (*C. W. J.*).

Poeciloscytus unifasciatus (Fabricius).

ME.— Capens, 11 July '07 (*C. W. J.*).

? VT.— (*fide Banks*).

Poeciloscytus basalis Reuter.

Me.— Orono, 15 Aug. '05; Westbrook, 13 Oct.

N. H.— Hanover, 5 July '92 (*A. P. M.*).

Vt.— Middlebury, 12 July.

Mass.— Beach Bluff, 24 Aug. '15 (*H. M. P.*); Edgartown, 22 Aug. '12 (*C. W. J.*); Fall River, 14 June '06 (*N. S. E.*); Forest Hills, 7 Sept. '14 (*H. M. P.*); Nantucket, 4 July '05 (*J. A. C.*); Provincetown, 27 June '91 (*A. P. M.*); Squantum, 3 Oct. '14 (*H. M. P.*); Woods Hole, July (*T. H. M.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*).

Conn.— Bantam, 19 June '14 (*W. E. B.*); East River, Sept. '10 (*C. R. E.*); New Haven, 17 June '02.

Poeciloscytus venaticus Uhler.

Me.— Machias, 22 July '09 (*C. W. J.*); Monmouth, 15 July '14 (*C. A. F.*); Staceyville, 15 Aug. '02 (*H. G. B.*).

N. H.— Glen House, 15 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*).

Vt.— Newport, 13 July '91 (*A. P. M.*); Norwich, 8 July '08 (*C. W. J.*).

Mass.— Amherst, 31 July '00; Auburndale, 28 June (*C. W. J.*); Framingham, 27 June '14 (*C. A. F.*); Newton, 16 June '14 (*J. R. T. B.*); Swampscott, 1 Aug. '14 (*H. M. P.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Colebrook, 20 July '05 (*W. E. B.*); Darien, 10 June '12 (*C. W. J.*); Greens Farms, 24 June (*W. E. B.*); Greenwich, 9 July '07 (*J. A. C.*); Hartford, 25 June '15 (*W. M.*); West Haven, 27 June '05 (*H. L. V.*).

Dichrooscytus suspectus Reuter.

Me.— Mt. Katahdin, 3000 ft., Aug. '02 (*H. G. B.*).

Mass.— Lowell (*fide Reuter*).

R. I.— Kingston, Sept. '07 (*J. B.*).

Conn.— Stonington, 15 July '14 (*I. W. D.*).

Horcias dislocatus (Say).

N. H.— Durham (*C. M. W. & W. F. F.*).

Conn.— Branford, 28 July '05 (*H. L. V.*); Darien, 10 June '12

(*C. W. J.*); New Haven, 1 June '11 (*B. H. W.*); S. Meriden, 1 June '15 (*H. L. J.*); Wallingford, '11 (*D. J. C.*); Winnipauk, 16 June '09 (*C. W. J.*).

Horcias dislocatus coccineus (Emmons) (= *H. d. scutellatus* Van Duzee).

N. H.— Durham (*C. M. W. & W. F. F.*).

Mass.— Forest Hills, 17 June '14 (*H. M. P.*).

Conn.— Branford, 5 July '05 (*H. W. W.*); S. Meriden, June '15 (*H. L. J.*).

Horcias dislocatus goniphorus (Say).

Me.— Liberty, 17 July '12 (*J. A. C.*); Monmouth, 15 July '14 (*C. A. F.*); Orono, 15 Aug.

N. H.— Durham (*C. M. W. & W. F. F.*); Hanover, 3 July '15 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Bennington, 19 June '15 (*C. W. J.*); Burlington, 23 June '06 (*C. W. J.*); St. Albans, 29 June '13 (*C. W. J.*).

Mass.— Amherst; Boston, 2 July '03 (*H. M. P.*); N. Adams, 20 June '06 (*C. W. J.*).

Conn.— Branford, 29 June '05 (*H. W. W.*); Litchfield, 28 June '03 (*L. B. W.*); New Haven, 1 June '11 (*B. H. W.*); S. Meriden, 10 June '14 (*H. L. J.*); Winnipauk, 16 June '09 (*C. W. J.*).

Horcias dislocatus limbatellus (Walker).

N. H.— Durham (*C. M. W. & W. F. F.*).

Vt.— Bennington, 19 June '15 (*C. W. J.*); St. Albans, 29 June '13 (*C. W. J.*).

Mass.— Amherst, 16 June '05.

Conn.— Branford, 5 July '05 (*H. W. W.*); New Haven, 1 June '11 (*B. H. W.*); S. Meriden, June '15 (*H. L. J.*); Winnipauk, 12 June '15 (*C. W. J.*).

Horcias dislocatus marginalis (Reuter).

Me.— Ft. Kent, 17 Aug. '10 (*C. W. J.*).

Vt.— Burlington, 22 June '06 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Conn.— Branford, 1 June '06 (*H. W. W.*); S. Meriden, June '15 (*H. L. J.*).

Horcias dislocatus nigrita Reuter.

Me.— Ft. Kent, 19 Aug. '10 (*C. W. J.*); Paris, 10 July '14 (*C. A. F.*).

N. H.— Durham (*C. M. W. & W. F. F.*).

Vt.— Burlington, 22 June '06 (*C. W. J.*); Jay, 17 July '91 (*A. P. M.*); Montpelier, 25 June '06 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); St. Albans, 29 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Auburndale, 25 June '05 (*C. W. J.*); Boston, 2 July '03 (*H. M. P.*).

Conn.— Branford, 27 June '04 (*H. L. V.*); Darien, 10 June '12 (*C. W. J.*); New Haven, 6 June '04 (*H. L. V.*); S. Meriden, 13 July '15 (*H. L. J.*); Winnipauk, 12 June '15 (*C. W. J.*).

Horcias dislocatus pallipes Van Duzee.

Me.— Ft. Kent, 17 Aug. '10 (*C. W. J.*).

N. H.— Hanover, 8 July '08 (*C. W. J.*).

Vt.— Burlington, 22 June '06 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Conn.— S. Meriden, June '15 (*H. L. J.*).

Poecilocapsus lineatus (Fabricius).

Me.— Capens, 12 July '07 (*C. W. J.*); Eastport, 16 July '09 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*); Orono; Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Glen House, 15 July '14 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Burlington, 22 June '06 (*C. W. J.*); Newport, 13 July '91 (*A. P. M.*); Stratton, 8 July '13 (*P. W. W.*).

Mass.— Amherst, 15 July '01; Eastham, 27 June '04 (*C. W. J.*); Forest Hills, 17 June '14 (*H. M. P.*); Springfield, 13 July '05

(*C. W. J.*); Rockport, 15 July '04 (*C. W. J.*); Woods Hole, 25 July '05 (*J. A. C.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Providence, 6 July (*C. A. D.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Greenwich, 9 July '07 (*J. A. C.*); Hartford, 26 June '14 (*W. M.*); New Haven, 12 June '96 (*W. E. B.*); S. Meriden, 6 July '14 (*H. L. J.*); Stonington, 5 July '06 (*J. A. H.*).

Division *Capsaria.*

Capsus ater (Linné).

Me.— Orono, 19 June '05.

N. H.— Bretton Woods, 24 June '13 (*C. W. J.*); Claremont (*R. P. D.*) (*fide Torre Bueno*); Durham (*C. M. W. & W. F. F.*); Glen House, 15 July '15 (*C. W. J.*); Hampton; Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 23 June '06 (*C. W. J.*); Newport, 12 July '91 (*A. P. M.*); St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Beach Bluff, 21 June '14 (*H. M. P.*); Cheshire, 20 June '06 (*C. W. J.*); Cohasset, 6 June (*O. B.*); Forest Hills, 1 June '15 (*H. M. P.*); Peru, June '04 (*J. B.*); West Springfield, 4 June '15 (*H. E. S.*); Winchendon, 1 July '92 (*A. P. M.*); Woods Hole, 1 July '05 (*J. A. C.*).

R. I.— Kingston, 17 June '05, 4 Aug. '05 (*J. B.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Middlebury, 16 June '10 (*B. H. W.*); Mt. Carmel, 22 June '08 (*W. E. B.*); New Haven, 20 May '04 (*B. H. W.*); Southington, 5 July '05 (*B. H. W.*); Windsor, 27 June '05 (*B. H. W.*).

Capsus ater tyrannus (Fabricius).

Me.— Capens, 18 July (*C. W. J.*); Paris, 8 July '14 (*C. A. F.*).

N. H.— Glen House, 15 July '15 (*C. W. J.*).

Vt.— Burlington, 23 June '06 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Amherst, 10 June '03; Beach Bluff, 21 June '14 (*H. M. P.*); Boston, 14 June '03 (*H. M. P.*); Woods Hole, 1 July '05 (*J. A. C.*).

Capsus ater semiflavus (Linné).

Me.— Eastport, 15 July '09 (*C. W. J.*); Holden, 18 June '04 (*F. A. E.*); Monmouth, 20 June '09 (*C. A. F.*).

N. H.— Jackson, 3 July '91 (*A. P. M.*).

Mass.— Amherst, 11 June '92; Beach Bluff, 21 June '15 (*H. M. P.*); Forest Hills, 17 June '14 (*H. M. P.*); Framingham, 24 Sept. '05 (*C. A. F.*); Sherborn, 10 June '94 (*A. P. M.*).

Conn.— New Haven, 22 June '04 (*B. H. W.*); Westville, 2 June '08 (*B. H. W.*).

Coccobaphes sanguinareus Uhler.

Me.— Manchester, 3 Aug. (*O. O. S.*); Monmouth, 27 June '06 (*C. A. F.*).

N. H.— Glen House, 25 July '14 (*C. W. J.*).

Vt.— Ascutney Mt., 2000 ft., 11 July '08 (*C. W. J.*); Montpelier, 25 June '06 (*C. W. J.*); Stratton, 1 July '13 (*P. W. W.*).

Mass.— Amherst, 4 Aug. '04; Mt. Greylock, 8 Aug. '07 (*C. W. J.*); Mt. Tom, July '14 (*C. W. J.*); Natick, 20 June '14 (*C. A. F.*); Sharon, 28 June '16 (*C. W. J.*).

Conn.— Hartford, 26 June (*W. M.*); Litchfield, 20 June '08 (*L. B. W.*); New Haven, 12 June '02 (*W. E. B.*); S. Meriden, 27 June '14 (*H. L. J.*).

Lygidea rubecula (Uhler).

Me.— Capens, 18 July '07 (*C. W. J.*); Machias, 19 July (*C. W. J.*).

N. H.— Fabyans (*W. F. F.*); Glen House, 15 July '15 (*C. W. J.*); Hanover, 3 July '15 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Lygidea mendax Reuter.

Me.— Orono, 30 June.

Conn.— New Haven, 15 June '14, 1 July '14 (*M. P. Z.*); Wallingford, 5 July '11 (*D. J. C.*).

Lygus pratensis punctatus (Zetterstedt).

Me.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10

(*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Orono, 7 May '14 (*H. M. P.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Jackson, 22 Sept. '07 (*O. B.*); Lebanon, 4 Sept. '15 (*H. E. S.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Brattleboro, 15 June '08 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); Forest Hills, 7 May '15 (*S. L. M.*); Hyde Park, 21 Oct. '15 (*H. M. P.*); Mt. Greylock, 15 June '06 (*C. W. J.*); Tisbury, 25 July '11 (*J. A. C.*); Tuckernuck Id., 5 Aug. '13 (*J. A. C.*); Nantucket, 19 Aug. '09 (*J. A. C.*); W. Springfield, 21 Oct. '15 (*H. E. S.*).

R. I.— Block Id., 28 Aug. '91 (*A. P. M.*); Buttonwoods, 25 July '11 (*C. W. J.*).

Conn.— Colebrook, 21 July '05 (*H. L. V.*); Greenwich, 9 July '07 (*C. W. J.*); Litchfield, 9 March '13 (*L. B. W.*); Mt. Carmel, 27 April '15 (*Q. S. L.*); Yalesville, 19 Oct. '03 (*H. L. V.*).

Lygus pratensis rubidus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Machias, 22 July '09 (*C. W. J.*); Orono, 5 June '13 (*H. M. P.*); Paris, 4 July '15 (*C. A. F.*).

N. H.— Bretton Woods, 27 June '13 (*C. W. J.*); Fabyans (*W. F. F.*); Glen House, 3 July '14 (*C. W. J.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*).

Vt.— Stratton, 8 July '13 (*P. W. W.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); Mt. Greylock, 15 June '06 (*C. W. J.*).

Lygus vanduzeei Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Belfast, 21 July '12 (*J. A. C.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*); Liberty, 17 July '12 (*J. A. C.*); Monmouth, 23 June '07 (*C. A. F.*); Northeast

Harbor, 27 Sept. '07 (*C. S. M.*); Orono, 7 Sept. '06; Township 2, Range 7, Penobscot Co., 2 Aug. '10 (*J. A. C.*).

N. H.— Bretton Woods, 26 June '13 (*C. W. J.*); Crawfords, 28 Oct. '16 (*H. M. P.*); Glen House, 15 July '15 (*C. W. J.*); Hanover, 3 July '15 (*C. W. J.*); Jackson, 22 Sept. '07 (*O. B.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*); Wonalancet, 13 Sept. '12 (*J. A. C.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Burlington, 22 June '06; Dummerston, 14 July '08 (*C. W. J.*); Manchester, 8 June '10 (*C. W. J.*); Montpelier, 25 June '06 (*C. W. J.*).

Mass.— Amherst, 23 June '04; Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Chester, 3 Aug. '11 (*C. W. J.*); E. Gloucester, 30 Aug. '12 (*C. W. J.*); Forest Hills, 24 Sept. '15 (*H. M. P.*); Mt. Greylock, 15 June '06 (*C. W. J.*); Mt. Tom, 14 July '05 (*C. W. J.*); N. Adams, 18 June '06 (*C. W. J.*); Southbridge, 8 July '13 (*C. W. J.*); Springfield, 13 July '05 (*C. W. J.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); S. Meriden, 7 July '15 (*H. L. J.*).

Lygus vanduzeei rubroclarus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Capens, 11 July '07 (*C. W. J.*); Machias, 26 July '06 (*C. W. J.*); Orono, 5 June '13 (*H. M. P.*).

N. H.— Bretton Woods, 30 June (*E. P. V. D.*); Fabyans (*W. F. F.*); Glen House, 3 July '14 (*C. W. J.*); Mt. Washington, 3000 ft., 8 July '14 (*C. W. J.*).

Vt.— Mt. Mansfield, 29 June (*G. P. E.*); Stratton, 8 July '13 (*P. W. W.*).

Mass.— Mt. Greylock, 15 June '06 (*C. W. J.*).

Lygus plagiatus Uhler.

Me.— (*fide Uhler*).

Mass.— Forest Hills, 30 Sept. '15 (*H. M. P.*); Pigeon Cove, 30 July '16 (*C. E. O.*); Swampscott, 19 Aug. '14 (*H. M. P.*).

R. I.— Kingston, 26 April '04 (*J. B.*).

Lygus rubicundus (Fallén).

Me.— Paris, 10 July '14 (*C. A. F.*).

Mass.— (*fide Uhler*).

Lygus campestris (Linné).

Me.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono, 2 May '13 (*H. M. P.*); Orr's Id., 25 July '09 (*C. W. J.*).

N. H.— Hanover, 3 July '13 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 23 July '12 (*C. W. J.*); Brattleboro, 15 June '08 (*C. W. J.*); Newport, 12 July '91 (*A. P. M.*); St. Albans, 21 June '13 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Mt. Tom, 14 July '05 (*C. W. J.*); Plymouth, 28 July '05 (*C. W. J.*).

Conn.— Branford, 28 July '05 (*H. H. W.*); Colebrook, 21 July '05 (*H. L. V.*); West Haven, 3 April '05 (*W. E. B.*); Westville, 2 June '08 (*B. H. W.*); Winnipauk, 16 June '09 (*C. W. J.*).

Lygus pabulinus signifer Reuter.

Me.— Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Mt. Katahdin (*H. G. B.*); Naples, 1 July '13 (*C. W. J.*); Orono, 17 Aug. '05; Traveller Mt., 27 July '12 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Glen House, 20 July '15 (*C. W. J.*); Hanover, 6 July '08 (*C. W. J.*); Mt. Washington, 3000 ft., 28 July '15 (*C. W. J.*); summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Killington Peak, 11 Aug. '93 (*A. P. M.*); Mt. Mansfield, 4000 ft., 21 July '91 (*A. P. M.*); Norwich, 8 July '08 (*C. W. J.*).

Mass.— Beach Bluff, 25 June '15 (*H. M. P.*); Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*); Chester, 8 Aug. '12 (*C. W. J.*); Manomet, 27 July (*W. S. B.*); Mt. Greylock, 15 June '06 (*C. W. J.*); Woods Hole (*C. T. B.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, 17 July '05 (*J. B.*).

Conn.— Cheshire, 8 July '04 (*H. L. V.*); Darien, 10 June '12 (*C. W. J.*); Middletown, 17 June '09 (*C. W. J.*); New Haven, 10 June '10 (*B. H. W.*); Stafford, 28 Aug. '05 (*W. E. B.*).

Lygus approximatus (Stål).

Me.— Mt. Katahdin, 3000 ft., Aug. '02 (*H. G. B.*).

N. H.— Mt. Washington, 2500 ft., 24 Sept. '07 (*O. B.*); Randolph, 18 Sept. (*W. T. D.*).

Lygus olivaceus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Manomet, 8 Aug. '12 (*W. S. B.*); Tisbury, 6 Aug. '11 (*J. A. C.*).

Conn.— East River, 7 Sept. '10 (*C. R. E.*).

Lygus olivaceus viridiusculus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Tisbury, 5 Aug. '11 (*J. A. C.*).

Lygus apicalis Fieber.

Me.— Liberty, 6 Sept. '13 (*J. A. C.*).

Lygus fagi Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

N. H.— Glen House, 15 July '15 (*C. W. J.*).

Vt.— Dummerston, 14 July '08 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); Mt. Greylock, 8 Aug. '12 (*C. W. J.*).

Lygus invitus (Say) Knight.

Can. Ent., 1917, vol. 48, p. 346.

Vt.— Burlington, 22 June '06 (*C. W. J.*); Norwich, 8 July (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— North Adams, 20 June (*C. W. J.*); Swampscott, 9 July '14 (*H. M. P.*).

Conn.— Danbury, 5 June '09 (*C. W. J.*); S. Meriden, June '15 (*H. L. J.*); Winnipauk, 16 June '09 (*C. W. J.*).

Lygus atritylus Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— Stowe, 29 June (*G. P. E.*).
N. H.— Franconia (*A. T. S.*).

Lygus confusus Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Machias, 22 July '09 (*C. W. J.*).
N. H.— Mt. Washington, 16 July.

Lygus alni Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

N. H.— Franconia (*A. T. S.*).

Lygus geneseensis Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Pigeon Cove, 28 July '16 (*C. E. O.*).

Lygus viburni Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— Bennington, 22 June '15 (*C. W. J.*).
Conn.— New Haven, 11 June '14 (*B. H. W.*).

Lygus parshleyi Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Eastport, 14 July '09 (*C. W. J.*).
N. H.— Bretton Woods, 26 June '13 (*C. W. J.*); Glen House, 23 July '15 (*C. W. J.*).

Lygus tiliae Knight.
Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— Middlebury, July '12.

Mass.— Springfield, 13 July '05 (*C. W. J.*).

Conn.— Middletown, 17 June '09 (*C. W. J.*); Poquonock, 27 June '05 (*H. L. V.*).

Lygus caryae Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— Bennington, 22 June '15 (*C. W. J.*).

Mass.— Amherst; Forest Hills, 17 June '14 (*H. M. P.*).

Conn.— New Haven, 24 June '05 (*B. H. W.*); Portland, 5 June '14 (*B. H. W.*); Yalesville, 27 June '07 (*B. H. W.*).

Lygus caryae subfuscus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Forest Hills, 11 June '14 (*H. M. P.*).

Conn.— Portland, 5 June '14 (*B. H. W.*).

Lygus vitticollis Reuter.

Me.— Orono, 12 July '05.

N. H.— Bretton Woods, 28 June '13 (*C. W. J.*); Mt. Washington, 2500 ft., 24 July '15 (*C. W. J.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*).

Mass.— Auburndale, 25 June '05 (*C. W. J.*); Blue Hills, 6 June (*C. W. J.*); Framingham, 11 June '11 (*C. A. F.*); Groton, 8 July '05 (*C. W. J.*); Pocasset, 6 Aug. '12 (*J. A. C.*); Rutland, 31 July '16 (*C. W. J.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); East River, Aug. '10 (*C. R. E.*); Litchfield, 20 June '08 (*L. B. W.*); New Haven, 9 June '05 (*B. H. W.*).

Lygus neglectus Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Manomet, 26 July; Tisbury, 25 July '11 (*J. A. C.*).

Lygus communis Knight.

Can. Ent., 1916, vol. 48, p. 346.

Me.— Capens, 12 July (*C. W. J.*); Eastport, 15 July '03 (*C.*

W. J.); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono; Paris, 10 July '14 (*C. A. F.*).

N. H.— Bretton Woods, 20 June (*E. P. V. D.*); Glen House, 24 July '15 (*C. W. J.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*); summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Bennington, 22 June '15 (*C. W. J.*); Burlington, 22 June '06 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Beach Bluff, 21 June '14 (*H. M. P.*); Cheshire, 20 June '06 (*C. W. J.*); N. Adams, 20 June '06 (*C. W. J.*).

Conn.— Middletown, 17 June '09 (*C. W. J.*); S. Meriden, June '15 (*H. L. J.*).

Lygus quercialbae Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Mass.— Forest Hills, 11 June '14 (*H. M. P.*); Springfield, 13 July.

Lygus omnivagus Knight.

Me.— Naples, 1 July '13 (*C. W. J.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Glen House, 24 July '15 (*C. W. J.*); Hanover, 3 July '15 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Burlington, 22 June '06 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*).

Mass.— Auburndale, 9 Aug. (*C. W. J.*); Beach Bluff, 4 July '15 (*H. M. P.*); Chilmark, 14 Aug. '14 (*J. A. C.*); Gloucester, 20 July (*W. L. M.*); Mt. Tom, 14 July '05 (*C. W. J.*); Pigeon Cove, 29 July (*C. E. O.*); Woods Hole, July (*T. H. M.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*); Kingston, 31 Aug. '07 (*J. B.*).

Conn.— Branford, 28 July '05 (*H. L. V.*); Danbury, 15 June '09 (*C. W. J.*); Darien, 10 June '12 (*C. W. J.*); Double Beach, 5 June (*H. L. V.*); Litchfield, 8 Aug. '12 (*L. B. W.*); Middletown, 17 June '09 (*C. W. J.*); New Haven, 8 June '04 (*B. H. W.*).

Lygus johnsoni Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— St. Johnsbury, 28 June '06 (*C. W. J.*).

Conn.— Middletown, 17 June '09 (*C. W. J.*).

Lygus belfragei Reuter.

Me.— Calais, 17 July '07 (*C. W. J.*); Capens, 17 July '07 (*C. W. J.*); Machias, 22 July '09 (*C. W. J.*); Princeton, 12 July '09 (*C. W. J.*).

N. H.— Glen House, 20 July '15 (*C. W. J.*); Hanover (*C. M. W.*); Mt. Washington, 3000 ft., 4 July '13 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Chester, 8 July '12 (*C. W. J.*); E. Gloucester, 30 Aug. '12 (*C. W. J.*); Forest Hills, 17 June '14 (*H. M. P.*); Manomet, 4 July '05 (*C. W. J.*); Mt. Greylock, 8 Aug. '07 (*C. W. J.*); Swampscott, 9 July '14 (*H. M. P.*).

R. I.— Kingston, 27 Aug. '07 (*J. B.*).

Lygus clavigenitalis Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Me.— Portland, 9 July (*E. P. V. D.*).

Lygus hirticulus Van Duzee (= *L. tenellus* Van Duzee).

Me.— Naples, 1 July '13 (*C. W. J.*); Orono, 25 July '05; Paris, 4 July '16 (*C. A. F.*).

N. H.— Glen House, 24 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, 3000 ft., 28 July '15 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*).

Mass.— Beach Bluff, 5 July '14 (*H. M. P.*); Mt. Greylock, 8 Aug. '07 (*C. W. J.*); Mt. Tom, 14 July '05 (*C. W. J.*); N. Adams, 18 June '06 (*C. W. J.*); Peru, 26 Aug. '04 (*J. B.*); Sherborn, 26 July '15 (*C. A. F.*).

Lygus ostryae Knight.

Bull. Cornell Agr. Exp. Sta., 1917, no. 391.

Vt.— Norwich, 8 July '08 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Brookline, 4 July (*C. W. J.*); N. Adams, 20 June '06 (*C. W. J.*).

Tropidosteptes cardinalis Uhler.

N. H.— Durham (*C. M. W. & W. F. F.*).

Vt.— Bennington, 19 June '15 (*C. W. J.*).

Mass.— Amherst, 16 June '05; Andover (*F. G. S.*) (*fide Uhler*); Groton, 8 July '05 (*C. W. J.*); N. Adams, 18 June '06 (*C. W. J.*).

Conn.— Darien, 10 June '12 (*C. W. J.*); Hamden, 28 May '11 (*B. H. W.*); Meriden, 3 June '10 (*W. E. B.*); New Haven, 3 June '08 (*B. H. W.*); Rowayton, 16 June '09 (*C. W. J.*).

Neoborus amoenus (Reuter).

Me.— Orono, 10 Sept. '85 (*H. T. F.*).

Vt.— St. Albans, 19 June '13 (*C. W. J.*).

Mass.— N. Adams, 20 June '08 (*C. W. J.*).

Conn.— New Haven, 28 Sept. '05 (*B. H. W.*).

Neoborus amoenus palmeri (Reuter).

Conn.— Washington, 24 June '14 (*G. H. V.*).

Neoborus amoenus scutellaris (Reuter).

N. H.— Hanover, 8 July '08 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); Waltham.

R. I.— Kingston, 8 Aug. '07 (*J. B.*).

Neoborus geminus (Say).

Mass.— Mt. Greylock.

Neoborus tricolor (Van Duzee).

Mass.— Cohasset, 6 June (*O. B.*); N. Adams, 18 June '06 (*C. W. J.*).

Neoborus pettiti (Reuter).

Conn.— New Haven, 28 April '05 (*B. H. W.*).

Neoborus canadensis (Van Duzee).

Mass.— Forest Hills, 11 June 1914 (*H. M. P.*).

Division *Deraeocoraria.*

Cimatlan catulum (Uhler).

Conn.— Wallingford, 20 July '10 (*D. J. C.*).

Cimatlan grossum (Uhler).

Mass.— Tyngsboro (*fide Knight*).

Camptobrochis nebulosus Uhler.

Me.— Ashland Jct., 16 Aug. '10 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*).

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, summit (*fide Slosson*).

Mass.— Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Forest Hills, 15 Jan. '15 (*S. M. D.*); Lynn, 18 Aug. '15 (*H. M. P.*); Melrose, Nov. '15 (*F. A. S.*); Wellesley, 14 May '16 (*H. M. P.*).

R. I.— Buttonwoods, 25 July '11 (*C. W. J.*).

Conn.— New Haven, 18 March '11 (*A. B. C.*); S. Meriden, 21 Feb. '15 (*H. L. J.*); Westville, 2 Dec. '05 (*W. E. B.*).

Camptobrochis validus cunealis Reuter.

Mass.— Chester, 7 Aug. '12 (*C. W. J.*); Forest Hills, 6 April '15 (*S. L. M.*).

Conn.— New Haven, 15 July (*A. B. C.*); Orange, 21 June '11 (*A. B. C.*).

Camptobrochis grandis Uhler.

Me.— Machias, 26 July '06 (*C. W. J.*); Orono, 1 July '05 (*E. M. P.*).

N. H.— Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Beach Bluff, 18 July '15 (*H. M. P.*); Chester, 8 Aug. '12 (*C. W. J.*); Danvers, 3 July '14; Natick, 20 June '14 (*C. A. F.*).

R. I.— Providence, 1 July '09 (*J. B.*).

Conn.— New Haven, 15 Aug. '05 (*W. E. B.*); S. Meriden, 4 July '14 (*H. L. J.*); Wallingford, 19 June '12 (*D. J. C.*).

Camptobrochis grandis nitens Reuter.

Me.— Mt. Katahdin, 3000 ft., Aug. '02 (*H. G. B.*); Orono, 11 July, 15 Aug. '05.

Mass.— Beach Bluff, 18 July '15 (*H. M. P.*); Blue Hills, 15 Sept. '14 (*H. M. P.*); Forest Hills, 17 Sept. '14 (*H. M. P.*); Saugus, 7 Sept. '14 (*H. M. P.*); Woods Hole, 5 Sept. '15 (*W. S. A.*).

Conn.— East River, 3 Aug. '10 (*C. R. E.*); New Haven, 14 Aug. '12 (*L. B. R.*); S. Meriden, 6 July '14 (*H. L. J.*); Wallingford, 19 June '12 (*D. J. C.*).

Deraeocoris ruber[1] (Linné).

Mass.— Beach Bluff, 12 July '14, 16 Aug. '15 (*H. M. P.*); Marblehead, 24 July '14 (*H. M. P.*).

Conn.— Hartford, 26 June '14 (*W. M.*); New Haven, 21 June '14 (*B. H. W.*), 21 July '14 (*M. P. Z.*).

BRYOCORINAE.

Tribe BRYOCORINI.

Sixeonotus insignis Reuter.

Mass.— Needham, 3 Sept. '11 (*C. W. J.*).

Conn.— Colebrook, 21 July '05 (*H. L. V.*).

Monalocoris filicis (Linné).

Me.— Ft. Kent, 17 Aug. '10 (*C. W. J.*); Machias, 22 July '09 (*C. W. J.*); Naples, 1 July '13 (*C. W. J.*); Orono, 31 May '14 (*H. M. P.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Cornish, 3 July '08; Glen House, 24 July '15 (*C. W. J.*); Mt. Washington, 4000 ft., 28 July '15 (*C. W. J.*); summit (*fide Slosson*).

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[1] Including several forms very similar to the named varieties of Europe.

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Jay Peak, 4018 ft., 14 July '91 (*A. P. M.*); Montpelier, 25 June '06 (*C. W. J.*); Mt. Mansfield, 4000 ft., 21 July '91 (*A. P. M.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

Mass.— Blue Hills, 22 May '15 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Chester, 8 Aug. '12 (*C. W. J.*); Forest Hills, 20 May '15 (*H. M. P.*); Mt. Tom, 14 July '05 (*C. W. J.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Lyme, 20 Aug. '10 (*B. H. W.*); Putnam, 12 July '15 (*H. L. V.*).

Cylapinae.

Tribe Cylapini.

Cylapus tenuicornis Say.

R. I.— Kingston, 19 Aug. '07 (*J. B.*).

Conn.— Winnipauk, 21 July '08 (*C. W. J.*).

Tribe Fulviini.

Fulvius brunneus (Provancher).

Me.— Orono (*H. T. F.*).

N. H.— Mt. Vernon, 6 Sept. '97 (*F. B.*).

Mass.— Fall River, 6 Aug. '10 (*N. S. E.*); Milton, 20 June '31 (*Harris Coll.*); Sherborn, 6 Sept. '14 (*C. A. F.*); Tyngsboro (*F. B.*); Wellesley, 15 Aug. '01 (*A. P. M.*).

R. I.— Kingston, 18 Aug. '07 (*J. B.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); New Haven, 28 Aug. '10 (*B. H. W.*).

Dicyphinae.

Tribe Hallodapini.

Orectoderus obliquus Uhler.

Me.— Machias, 22 July '09 (*C. W. J.*).

Mass.— Auburndale, 15 June '05 (*C. W. J.*); Berlin, 13 June '15 (*C. A. F.*); Lowell (*fide Kirkaldy*); Manomet, 16 June '12 (*W. S.*

B.); Provincetown, 24 June '04 (*C. W. J.*); Wachusett, 22 June '78; Woods Hole, 2 July '05 (*J. A. C.*).

R. I.— Kingston, 23 June '06 (*J. B.*).

CONN.— (*fide Uhler*).

Coquillettia mimetica Osborn.

MASS.— Dover, 7 July '94 (*A. P. M.*); Edgartown, 28 June '10 (*C. W. J.*); Framingham, 20 July '12 (*C. A. F.*); Woods Hole, July (*T. H. M.*).

Tribe DICYPHINI.

Hyaliodes vitripennis (Say).

ME.— Ashland Jct., 16 Aug. '10 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*).

N. H.— Crawfords (*W. F. F.*); Hanover (*C. M. W.*).

VT.— Norwich, 8 July '08 (*C. W. J.*).

MASS.— Chester, 8 Aug. '12 (*C. W. J.*); Fall River, 22 July '05 (*N. S. E.*); Forest Hills, 14 Sept. '14 (*H. M. P.*); Williamsburg, 7 Aug. '11 (*C. W. J.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, 10 Aug. '07 (*J. B.*).

CONN.— Brookfield, 27 July '10 (*E. L. D.*); Mt. Carmel, 24 July '04 (*W. E. B.*); New Canaan, 14 Sept. '05 (*W. E. B.*); Pine Orchard, 26 July '04 (*W. E. B.*); Portland, 10 Aug. '13 (*B. H. W.*); Rowayton, 5 Aug. (*C. W. J.*).

Dicyphus agilis (Uhler).

ME.— Capens, 12 July '07 (*C. W. J.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Pownal (*O. O. S.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Fabyans (*W. F. F.*); Glen House, 24 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, 4000 ft., 28 July '15 (*C. W. J.*); summit (*fide Slosson*).

VT.— Ascutney Mt., 23 July '12 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); St. Johnsbury, 28 June '06 (*C. W. J.*).

MASS.— Brookline, 4 July (*C. W. J.*); Chester, 8 Aug. '12 (*C. W. J.*); Waltham.

CONN.— Colebrook, 21 July '05 (*H. L. V.*); Hamden, 25 June '11 (*B. H. W.*); New Haven, 15 June '04 (*W. E. B.*); Poquonock, 27 June '05 (*H. L. V.*).

Dicyphus famelicus (Uhler).

ME.— Liberty, 13 Sept. '13 (*J. A. C.*).

N. H.— Hanover, 6 July '08 (*C. W. J.*); Mt. Washington, 8 July '14 (*C. W. J.*); summit (*fide Slosson*).

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Montpelier, 25 June '06 (*C. W. J.*); St. Albans, 19 June '13 (*C. W. J.*).

MASS.— Amherst, 1 Aug. '00; Blue Hills, 15 Sept. '14 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Chester, 26 May '12 (*C. W. J.*); Forest Hills, 19 Sept. '14 (*H. M. P.*); Lynn, 18 Aug. '15 (*H. M. P.*); Saugus, 7 Sept. '14 (*H. M. P.*).

Macrolophus separatus (Uhler).

MASS.— Brookline, 25 Sept. '13 (*C. W. J.*); Lynn, 2 Sept. '14 (*H. M. P.*); Saugus, Aug. '06.

ORTHOTYLINAE.

Tribe ORTHOTYLINI.

Division *Laboparia.*

Labops hesperius Uhler.

ME.— Monmouth, 16 June (*C. A. F.*); Paris, 4 July '15 (*C. A. F.*); Skowhegan, 19 June '00 (*O. O. S.*).

N. H.— Bretton Woods, 24 June '13 (*C. W. J.*); Concord, 4 June '15 (*H. E. S.*); Durham (*C. M. W. & W. F. F.*); Hanover (*C. M. W.*); Jackson, 3 July '91 (*A. P. M.*); Mt. Washington, below Halfway House, 8 July '91 (*A. P. M.*); summit (*fide Slosson*).

VT.— Ascutney Mt., 11 July '08 (*C. W. J.*); Mt. Mansfield, 21 July '91 (*A. P. M.*); Stratton, 10 July '13 (*P. W. W.*).

MASS.— Winchendon, 1 July '92 (*A. P. M.*).

Division *Halticaria.*

Halticus apterus (Linné).

Me.— Patten, 2 Sept. '03 (*O. O. S.*).

Halticus intermedius Uhler.

Me.— Orono (*H. T. F.*); Township 4, Range 7, Penobscot Co., 1 Aug. '10 (*J. A. C.*).

Mass.— Boston, Chestnut Hill, 24 Sept. '14 (*H. M. P.*).

Conn.— Branford, 28 July '05 (*H. L. V.*); S. Meriden, 13 July '15 (*H. L. J.*).

Halticus citri Ashmead.

Me.— Pownal (*O. O. S.*).

Mass.— Amherst, 29 Sept. '96; Beverly, 4 Oct. '71 (*E. B.*).

Conn.— Kent, 31 Aug. '04 (*W. E. B.*); New Haven, 16 Oct. '03 (*H. L. V.*); Southport, 9 Sept. '04 (*W. E. B.*).

Strongylocoris stygicus (Say).

Me.— Bowlin Pond, 31 July '10 (*J. A. C.*); Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*); Machias, 22 July '09 (*C. W. J.*); Paris, 4 July '15 (*C. A. F.*).

N. H.— Fitzwilliam, July '07 (*J. H. E.*); Glen House, 20 July '15 (*C. W. J.*); Hanover, 3 July '15 (*C. W. J.*); Mt. Washington, 4000 ft., 28 July '15 (*C. W. J.*); summit, 4 July '14 (*C. A. F.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Bennington, 22 June '15 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Manchester, 8 June '10 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Amherst, 31 July '00; Beach Bluff, 14 July '14 (*H. M. P.*); Fall River, 17 June '05 (*J. A. C.*); Peru, 29 Aug. '04 (*J. B.*); Springfield, 13 July '05 (*C. W. J.*); Williamsburg, 7 Aug. '11 (*C. W. J.*).

R. I.— Kingston, 5 July '07 (*J. B.*).

Conn.— Danbury, 15 June '09 (*C. W. J.*); Darien, 10 June '12 (*C. W. J.*); Greenwich, 9 July '09 (*J. A. C.*); New Haven, 26 June '05 (*B. H. W.*); S. Meriden, 13 July '15 (*H. L. J.*); Winnipauk, 16 June '09 (*C. W. J.*).

Division *Pilophoraria.*

Heterocordylus malinus Reuter.

N. H.— Durham (*C. M. W. & W. F. F.*); Mt. Washington, 4 July '14 (*C. A. F.*).

Pilophorus amoenus Uhler.

Me.— Paris, 15 July '14 (*C. A. F.*).

N. H.— Mt. Washington, summit (*fide Slosson*).

Mass.— Cambridge; Marblehead, 24 July '14 (*H. M. P.*); Saugus, 7 Sept. '14 (*H. M. P.*).

Sericophanes noctuans Knight.

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Mass.— Woods Hole, July (*T. H. M.*).

Conn.— New Haven, 30 May '11 (*B. H. W.*).

Division *Ceratocapsaria.*

Ceratocapsus modestus (Uhler).

Vt.— Woodstock, 22 July '09 (*A. P. M.*).

Mass.— Amherst, 23 July '97; Beach Bluff, 13 Aug. '14 (*H. M. P.*).

Conn.— East River, 5 Aug. '10 (*C. R. E.*); New Haven, 8 July '09 (*B. H. W.*); S. Meriden, 6 July '14 (*H. L. J.*); Stonington, 7 July '14 (*I. W. D.*).

Ceratocapsus pumilus (Uhler).

Me.— Orono, July, 10 Aug. '13.

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); E. Gloucester, 30 Aug. '12 (*C. W. J.*); Mt. Tom, 14 July '05 (*C. W. J.*); Natick; Saugus, 22 Aug. '14 (*H. M. P.*); Sherborn, 30 July '16 (*C. A. F.*).

Ceratocapsus fasciatus (Uhler).

Mass.— Pigeon Cove, 28 July '16 (*C. E. O.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Division *Lopidearia.*

Lopidea caesar (Reuter).

Mass.— Fall River, 7 Aug. '08 (*N. S. E.*); Rutland, 31 July '16 (*C. W. J.*).

Conn.— Portland, 14 July '14 (*M. P. Z.*); 10 Aug. '13 (*B. H. W.*).

Lopidea instabilis (Reuter).

N. H.— Durham (*C. M. W. & W. F. F.*); Holderness, 1 Aug. '99 (*A. P. M.*); Webster (*W. F. F.*).

Vt.— Brattleboro, 15 June '08 (*C. W. J.*).

Mass.— Auburndale, 6 Aug. '05 (*C. W. J.*); Fall River, 22 July '05 (*J. A. C.*); Springfield, 13 July '05 (*C. W. J.*).

R. I.— Kingston, 10 Aug. '07 (*J. B.*).

Conn.— Meriden, 15 July '09 (*A. I. B.*); New Haven, 6 July '04 (*H. L. V.*), 14 Aug. '06 (*W. E. B.*).

Lopidea instabilis marginalis (Reuter).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*).

Mass.— Auburndale, 6 Aug. '05 (*C. W. J.*).

Lopidea media (Say).

Me.— Ashland Jct., 16 Aug. '10 (*C. W. J.*); Belfast, 21 July '12 (*J. A. C.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Mistake Id., 9 Aug. '07 (*J. A. C.*); Paris, 10 July '14 (*C. A. F.*); Princeton, 12 July '09 (*C. W. J.*); Township 4, Range 7, Penobscot Co., 1 Aug. '10 (*J. A. C.*).

N. H.— Crawfords, 28 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Fabyans (*W. F. F.*); Glen House, 15 July '15 (*C. W. J.*); Hanover (*C. M. W.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*); Ascutney Mt., 11 July '08 (*C. W. J.*); Bennington, 19 June '15 (*C. W. J.*).

Mass.— Beach Bluff, 9 July '14 (*H. M. P.*); Fall River, 22 July '05 (*J. A. C.*); Forest Hills, 28 June '79 (*S. H.*); Mt. Tom, 14 July '05 (*C. W. J.*); Peru, Sept. '08 (*J. B.*); Southbridge, 16 July '14 (*C. W. J.*).

R. I.— Kingston, 17 July '05 (*J. B.*).

Conn.— New Haven, 9 June '05 (*B. H. W.*); Portland, 14 July '14 (*M. P. Z.*); Rainbow, 30 June '14 (*B. H. W.*); S. Meriden, 6 July '14 (*H. L. J.*); Woodbury, 14 July '13 (*W. E. B.*).

Lopidea confluens (Say).

N. H.— Mt. Washington, summit (*fide Slosson*).

Mass.— Chester, 3 Aug. '11 (*C. W. J.*); Williamsburg, 7 Aug. '11 (*C. W. J.*).

Lopidea robiniae (Uhler).

N. H.— Lee (*C. M. W. & W. F. F.*).

Vt.— Middlebury, July '12.

Mass.— Beach Bluff, 22 Aug. '14 (*H. M. P.*); Beverly, 22 Aug. '04; Fall River, 20 July '09 (*N. S. E.*); Springfield, 13 July '05 (*C. W. J.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, 26 Aug. '07 (*J. B.*).

Conn.— Branford, 29 July '05 (*H. W. W.*); New Haven, 3 Aug. '05 (*H. L. V.*); Westville, 27 July '05 (*W. E. B.*).

Division *Orthotylaria.*

Pseudoxenetus scutellatus (Uhler).

Mass.— Amherst, 9 June '99; Brookline, 21 June '77 (*S. H.*); Forest Hills, 17 June '14 (*H. M. P.*); Newton, 16 June '14 (*J. R. T. B.*).

R. I.— Providence, 11 June '09.

Conn.— Branford, 8 June '12 (*B. H. W.*); Danbury, 15 June '09 (*C. W. J.*); Darien, 10 June '12 (*C. W. J.*); Litchfield, 30 June '16 (*L. B. W.*); New Haven, 12 June '10 (*A. B. C.*); S. Meriden, 14 June '15 (*H. L. J.*).

Diaphnidia debilis Uhler.

Mass.— Chester, 8 Aug. '12 (*C. W. J.*).

Diaphnidia pellucida Uhler.

Me.— Orono, 22 July.

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*); Framingham, 7 Sept. '14 (*C. A. F.*).

Diaphnidia provancheri Burque.

Mass.— Beach Bluff, 25 June '14 (*H. M. P.*).

Orthotylus flavosparsus (Sahlberg).

Me.— Orono, 22 July '07; Pownal, 28 Sept. '01 (*O. O. S.*).

Mass.— Amherst, 31 July '00; Beach Bluff, 24 July '14 (*H. M. P.*); Cohasset, 8 Sept., (*O. B.*); Framingham, 15 Sept. '15 (*C. A. F.*).

Conn.— New Canaan, 29 Sept. '09 (*W. E. B.*); New Haven, 26 June '05 (*H. L. V.*); S. Meriden, 16 July '15 (*H. L. J.*); Stratford, 21 July '08 (*W. E. B.*).

Orthotylus chlorionis (Say).

Mass.— Beach Bluff, 9 July '15 (*H. M. P.*); Forest Hills, 17 June '14 (*H. M. P.*).

Conn.— New Haven, 22 June '05 (*H. L. V.*); Noroton, 21 June '13 (*A. H. R.*).

Orthotylus catulus Van Duzee.

Me.— Bowlin Pond, 31 July '10 (*J. A. C.*); Traveller Mt., 29 July '10 (*J. A. C.*).

Orthotylus dorsalis (Provancher).

Me.— Calais, 10 July '09 (*C. W. J.*); Machias, 17 July '09 (*C. W. J.*).

N. H.— Hanover, 8 July '08 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Winchendon, 1 July '92 (*A. P. M.*); Woods Hole (*fide T. H. M.*).

R. I.— Kingston, 23 June '06 (*J. B.*).

Orthotylus marginatus (Uhler).

Me.— Eastport, 15 July '09 (*C. W. J.*); Moosehead, 18 July '07 (*C. W. J.*).

Mass.— Winchendon, 1 July '92 (*A. P. M.*).

Orthotylus cruciatus Van Duzee.

Me.— Portland, 9 July '10 (*E. P. V. D.*).

Vt.— Stowe, 4 July (*G. P. E.*) (*fide E. P. V. D.*).

Mass.— Amherst, 23 June '96; Danvers, 3 July '14; Marshfield, Aug.; Sherborn, 24 June '14 (*C. A. F.*); Swampscott, 13 July '15 (*H. M. P.*).

Conn.— Hartford, 25 June '14 (*W. M.*); New Haven, 23 June '11 (*A. B. C.*).

Orthotylus candidatus Van Duzee.

N. H.— Mt. Washington (*A. T. S.*).

Orthotylus necopinus Van Duzee.

N. H.— Bretton Woods, 30 June '09 (*E. P. V. D.*); Mt. Washington, Alpine Garden, 4 July '14 (*C. W. J.*).

Ilnacora malina (Uhler).

Me.— Holden, 9 July '96 (*F. A. E.*); Machias, 26 July '09 (*C. W. J.*); Monmouth, 29 June '05 (*C. A. F.*); Paris, 9 July '15 (*C. A. F.*).

N. H.— Fabyans (*W. F. F.*); Glen House, 24 July '15 (*C. W. J.*).

Vt.— Amsden, 10 July '08 (*C. W. J.*); Ascutney Mt., 11 July '08 (*C. W. J.*); Norwich, 8 July '08 (*C. W. J.*); Stratton, 8 July '13 (*P. W. W.*).

Mass.— Newton, 16 June '14 (*J. R. T. B.*); Springfield, 13 July '05 (*C. W. J.*); Winchendon, 1 July '92 (*A. P. M.*).

Conn.— S. Meriden, 7 July '15 (*H. L. J.*).

Mecomma ambulans (Fallén).

Me.— Eastport, 15 July '09 (*C. W. J.*); Ft. Kent, 19 Aug. '10 (*C. W. J.*); Machias, 22 July '09 (*C. W. J.*); Mt. Katahdin, 3000 ft., Aug. '02 (*H. G. B.*).

N. H.— Fabyans (*W. F. F.*); Glen House, 24 July '15 (*C. W. J.*); Mt. Washington, 2500 ft., 18 July '15; 4000 ft., 28 July '15 (*C. W. J.*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*).

Mass.— Chester, 8 Aug. '12 (*C. W. J.*).

Orthocephalus mutabilis (Fallén).

Me.— Orono, 2 July '15 (Knight has compared the specimen recorded with European examples sent by Reuter to the U. S. National Museum).

Parthenicus vaccinii Van Duzee.

Mass.— Ipswich, 22 July '09 (*E. P. V. D.*).

Phylinae.

Tribe Phylini.

Division *Oncotylaria.*

Macrotylus sexguttatus (Provancher).

N. H.— Glen House, 20 July '15 (*C. W. J.*).

Macrotylus amoenus Reuter.

Mass.— Mt. Tom, 14 July '05 (*C. W. J.*).

Conn.— Westville, 4 July '04 (*W. E. B.*).

Onychumenus decolor (Fallén).

Me.— Ft. Kent, 19 Aug. '10 (*C. W. J.*); Ironbound Id., 10 Aug. '08 (*J. A. C.*); Machias, 22 July '09 (*C. W. J.*); Mistake Id., 9 Aug. '07 (*J. A. C.*); Monmouth, 16 July '14 (*C. A. F.*); Traveller Mt., 29 July '10 (*J. A. C.*).

N. H.— Dublin, 1 Aug.

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Dummerston, 14 July '08 (*C. W. J.*); Middlebury, 12 July.

Mass.— Beach Bluff, 14 July '14 (*H. M. P.*); Mt. Greylock, 8 Aug. '07 (*C. W. J.*); Tisbury, 25 July '11 (*J. A. C.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, 17 July '05 (*J. B.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*); Colebrook, 21 July '05 (*H. L. V.*); Danbury, 15 June '09 (*C. W. J.*); New Haven, 11 July '04 (*P. L. B.*); West Thompson, 12 July '05 (*H. L. V.*); Woodbury, 16 July '13 (*W. E. B.*).

Division *Phylaria.*

Reuteroscopus ornatus (Reuter).

Conn.— New Haven, 26 June '12, 28 Aug. '10 (*B. H. W.*).

? **Psallus juniperi** Heidemann.

Me.— Paris, 10 July '14 (*C. A. F.*).

Mass.— Beach Bluff, 28 June '15 (*H. M. P.*); Swampscott, 11 Aug. '15 (*H. M. P.*).

Microphylellus modestus Reuter.

Me.— Machias, 26 July '09 (*C. W. J.*).

Conn.— New Haven, 27 June '13 (*L. B. R.*).

Rhinocapsus vanduzeii Uhler.

Me.— Liberty, 17 July '12 (*J. A. C.*); Machias, 22 July '09 (*C. W. J.*).

N. H.— Glen House, 24 July '15 (*C. W. J.*); Hanover, 8 July '08 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Ascutney Mt., 11 July '08 (*C. W. J.*); Brattleboro, 15 June '08 (*C. W. J.*).

Mass.— Fall River, 11 July '13 (*N. S. E.*); Pocasset, 6 Aug. '12 (*J. A. C.*); Rockport, July (*C. W. J.*); Southbridge, 16 July '14 (*C. W. J.*).

Conn.— Brookfield, 27 July '10 (*E. L. D.*).

Plagiognathus[1] **obscurus** Uhler.

Me.— Calais, 10 July '09 (*C. W. J.*); Ft. Kent, 17 Aug. '10 (*C. W. J.*); Monmouth, 15 July '14 (*C. A. F.*); Orono, 16 July '07.

N. H.— Glen House, 24 July '15 (*C. W. J.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Dummerston, 14 July '08 (*C. W. J.*); Jay, 17 July '91 (*A. P. M.*); Mt. Mansfield, 21 July '91 (*A. P. M.*); Norwich, 8 July '08 (*C. W. J.*).

Mass.— Beach Bluff, 9 July '14 (*H. M. P.*); Cohasset, 21

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[1] A number of forms of Plagiognathus and allied genera are at hand which are not recorded here on account of uncertainty in determination.

Sept. '14 (*H. M. P.*); Forest Hills, 4 Oct. '15 (*H. M. P.*); Southbridge, 16 July '14 (*C. W. J.*).

R. I.— Cumberland; Kingston, 11 July '10 (*J. B.*).

Conn.— East River, Aug. '10 (*C. R. E.*); New Haven, 19 July '05 (*B. H. W.*).

Apocremnus politus (Uhler).

Me.— Machias, 22 July '09 (*C. W. J.*); Orono, 14 July.

Mass.— Agawam, 16 Aug. '15 (*H. E. S.*); Beach Bluff, 22 June '14 (*H. M. P.*); Boston, Chestnut Hill, 13 Oct. '15 (*H. M. P.*); Peru, 29 Aug. '04 (*J. B.*).

R. I.— Kingston, 15 July '05 (*J. B.*); Providence, 7 July (*C. A. D.*).

Conn.— Cheshire, 8 July '04 (*H. L. V.*); Litchfield, 13 July '01 (*L. B. W.*); Mt. Carmel, 24 Aug. '06 (*B. H. W.*); New Haven, 23 June '04 (*H. L. V.*); W. Thompson, 12 July '05 (*H. L. V.*).

Chlamydatus associatus (Uhler).

Mass.— Beach Bluff, 13 Aug. '14 (*H. M. P.*); Boston, 16 May (*C. W. J.*); Forest Hills, 19 Sept. '14 (*H. M. P.*); Nantucket, 22 Aug. '11 (*H. T. F.*); Wellesley, 9 Oct. '90 (*A. P. M.*); Wollaston, 5 Sept. (*C. W. J.*).

Conn.— New Haven, 12 Sept. '04 (*B. H. W.*).

Campylomma verbasci (Meyer-Dür).

Me.— Pownal, 26 Aug. '00 (*O. O. S.*).

Mass.— Beach Bluff, 22 June '14, 2 Sept. '14 (*H. M. P.*).

Conn.— Hamden, 14 June '11 (*W. E. B.*); New Haven, 21 June '09 (*B. H. W.*); Westville, 6 Aug. '05 (*W. E. B.*).

HYDROMETRIDAE.

Hydrometra martini Kirkaldy.

Me.— Monmouth, 11 July (*C. A. F.*); Orono, 6 May '14 (*H. M. P.*).

N. H.— Durham (*W. F. F.*).

Mass.— Brookline, 15 May '77 (*S. H.*); Cohasset, June '05 (*O. B.*); Forest Hills, 9 May '16 (*H. M. P.*); Framingham, 25 May '15 (*C. A. F.*); Provincetown, 1 Sept. '14; Somerset, 2 July '06 (*C. W. J.*); Woods Hole (*fide T. H. M.*).

R. I.— Kingston, 19 May '13, 11 July '10 (*J. B.*).

GERRIDAE.

Gerrinae.

Gerris remigis Say.

Me.— Auburn (*E. D. M.*); Bethel (*A. M. E.*); Orono, 20 April, 17 May '13 (*H. M. P.*).

N. H.— Crawfords, 2 Oct. '16 (*H. M. P.*); Durham, 14 April '99, Dec. '08 (*W. F. F.*); Mt. Washington, summit (*fide Slosson*).

Vt.— Woodstock, 18 Aug. '98 (*A. P. M.*).

Mass.— Brookline, 30 March '78 (*S. H.*); Danvers, 18 May '14; Forest Hills, 23 Feb. '15, 16 Sept. '14 (*H. M. P.*); Wellesley, 20 April '99 (*A. P. M.*).

R. I.— Kingston, 15 April '10 (*J. B.*).

Conn.— Farmington, 24 May '14 (*W. M.*); New Haven, 18 March '11 (*B. H. W.*); Torrington, 7 July '05 (*W. E. B.*); Winnipauk, 4 Aug. '08 (*C. W. J.*).

Gerris conformis (Uhler).

Me.— Orono, Sept.

N. H.— Durham (*C. M. W. & W. F. F.*).

Mass.— Amherst, 11 June '92; Chicopee (*R. H. W.*); Milton, 20 Sept. '21 (*Harris Coll.*); Natick; Wellesley, 28 April '99 (*A. P. M.*).

Conn.— Hamden, 1 April '11 (*B. H. W.*); Hartford, 14 May '14 (*W. M.*); Orange, 21 May '11 (*B. H. W.*).

Gerris marginatus Say.

Me.— Durham; Norway, 19 July (*O. O. S.*); Orono, 6 May '14 (*H. M. P.*); Westbrook.

N. H.— Crawfords, 2 Oct. '16 (*H. M. P.*); Durham, 20 Sept. '01.

Mass.— Amherst; Beach Bluff, 18 July '15 (*H. M. P.*); Forest Hills, 8 April '15 (*F. G. C.*), 1 Oct. '15 (*H. M. P.*); Lynn, 18 Aug. '15 (*H. M. P.*); Woods Hole (*C. T. B.*).

R. I.— Kingston, 13 April '10 (*J. B.*); Providence, 5 May (*C. A. D.*).

Conn.— Cheshire, 6 May '11 (*B. H. W.*); Lyme, 14 May '11 (*A. B. C.*); New Haven, 4 May '11 (*B. H. W.*); Putnam, 12 July '05 (*H. L. V.*); S. Meriden, 26 April '14 (*H. L. J.*).

Gerris argenticollis Parshley.

Ent. News, 1916, vol. 27, p. 103.

Mass.— 19 April '16, 20 May '15 (*H. M. P.*).

Gerris buenoi Kirkaldy.

Me.— Orono, 19 April '14, 15 Sept. '13 (*H. M. P.*).

N. H.— Crawfords, 23 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Mt. Washington, Alpine Garden, 4 July '14 (*C. W. J.*).

Vt.— Norwich, 18 May '91 (*C. M. W.*).

Mass.— Cambridge, 4 May '68 (*E. B.*); Forest Hills, 8 April '15 (*F. G. C.*), 1 Oct. '15 (*H. M. P.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, 29 April '10, Sept. '07 (*J. B.*).

Conn.— Cheshire, 6 May '11 (*B. H. W.*); Litchfield, 26 July '01 (*L. B. W.*); Milford, 10 Aug. '05 (*W. E. B.*); New Haven, 14 April '11 (*B. H. W.*).

Gerris canaliculatus Say.

Mass.— Beverly, 23 May '78 (*E. B.*); Cambridge; Forest Hills, 9 May '16, 1 Oct. '15 (*H. M. P.*); Milton, 23 April '16 (*E. W. T.*).

R. I.— Kingston, 15 April '10, 3 May '08 (*J. B.*).

Conn.— Hamden, 24 Oct. '10 (*B. H. W.*); New Haven, 4 May '11 (*B. H. W.*).

Limnoporus rufoscutellatus (Latreille).

Me.— Brunswick; Norway (*S. J. S.*); Orono, 6 May '14 (*H. M. P.*), 19 July '05.

N. H.— Crawfords, 2 Oct. '16 (*H. M. P.*); Mt. Washington, Lake of the Clouds, 1 July (*C. A. F.*); summit, 9 July '91 (*A. P. M.*).

Mass.— Beverly, 9 Oct. '75 (*E. B.*); Forest Hills, 9 May '16 (*H. M. P.*); Brookline, 21 June '78 (*S. H.*); Sherborn, 14 April '99 (*A. P. M.*); Wellesley, 10 Sept. '04 (*A. P. M.*).

R. I.— Kingston, 26 April '04 (*J. B.*); Providence, 20 June (*C. A. D.*).

Conn.— New Haven, 28 April '11 (*B. H. W.*).

Halobatinae.

Metrobates hesperius Uhler.

Me.— Orono, 22 Sept. '09.

Mass.— Cambridge; Dover, 23 Aug. '01 (*A. P. M.*); Sherborn, 5 Aug. '96 (*A. P. M.*); Wellesley, 6 Aug. '00 (*A. P. M.*).

R. I.— Kingston, 18 Oct. '05 (*J. B.*).

Trepobates pictus (Herrich-Schaeffer).

Me.— Mistake Id., 9 Aug. '07 (*J. A. C.*); Orono, 15 Sept. '13 (*H. M. P.*); Roque Bluff, 15 Aug. '07 (*J. A. C.*).

N. H.— Durham, 15 Aug. '00 (*W. F. F.*).

Mass.— Cambridge; Wellesley, 15 Aug. '07 (*A. P. M.*); Winchester, 12 Sept. '07 (*A. P. M.*).

R. I.— Kingston, 12 July '10 (*J. B.*).

VELIIDAE.

Microvelia borealis Torre Bueno.

Bull. Brooklyn Ent. Soc., 1916, vol. 11, p. 59.

Me.— Orono, 3 May '14 (*H. M. P.*).

Mass.— Forest Hills, 20 Oct. '14 (*H. M. P.*); Saugus, 22 Aug. '14 (*H. M. P.*).

Microvelia fontinalis Torre Bueno.

Bull. Brooklyn Ent. Soc., 1916, vol. 11, p. 58.

Mass.— Danvers, 3 Aug. '15 (*H. M. P.*).

Microvelia albonotata Champion.

Mass.— Danvers, 3 Aug. '15 (*H. M. P.*).

Microvelia americana (Uhler).

Me.— Orono, 17 May '13, 19 Sept. '13 (*H. M. P.*); Paris, 10 July '14 (*C. A. F.*); Pownal (*O. O. S.*).

N. H.— Crawfords, 2 Oct. '16 (*H. M. P.*).

Vt.— Dummerston, 14 July '08 (*C. W. J.*).

Mass.— Dover, 16 Aug. '00 (*A. P. M.*); Fall River, 1 April '05 (*N. S. E.*); Forest Hills, 24 March '15, 16 Sept. '14 (*H. M. P.*).

R. I.— Kingston, 29 April '10 (*J. B.*).

Conn.— Cheshire, 6 May '11 (*B. H. W.*); Hamden, 25 May '11 (*B. H. W.*).

Rhagovelia obesa Uhler.

Me.— Paris, 15 July '14 (*C. A. F.*).

Vt.— Norwich, 8 July '08 (*C. W. J.*).

Mass.— Dover, 23 Aug. '01 (*A. P. M.*); Milton, 30 Sept. (*Harris Coll.*); Waltham (*P. R. U.*); Wellesley, 6 Aug. '00 (*A. P. M.*).

SALDIDAE.

Saldinae.

Pentacora signoreti (Guérin).

Mass.— Woods Hole, 22 July '99.

Pentacora ligata (Say).

Me.— Magalloway River (*O. O. S.*); Norway (*O. O. S.*).

N. H.— Glen House, 20 July '15 (*C. W. J.*); Hanover, 6 July '08 (*C. W. J.*).

Vt.— Middlebury, July '12.

Mass.— Mt. Everett, 28 June '12 (*C. W. J.*); Waltham.

Salda coriacea Uhler.

Me.— Holden, 4 July '13 (*F. A. E.*); Monmouth, 15 July '14 (*C. A. F.*); Wales, 12 June '09 (*C. A. F.*).

Mass.— Andover (*F. G. S.*) (*fide Uhler*); Beach Bluff, 21 June '15 (*H. M. P.*); Cambridge, 20 June '24 (*Harris Coll.*); Sherborn, 19 June '15 (*C. A. F.*).

Conn.— Orange, 4 June '10 (*B. H. W.*).

Saldula major (Provancher).

Me.— Monmouth, 29 June '07 (*C. A. F.*); Orono, 4 Sept. '85 (*H. T. F.*).

N. H.— Mt. Washington, 5000 ft., 26 June '91 (*A. P. M.*).

Mass.— Beach Bluff, 11 Aug. '16 (*H. M. P.*); Brighton, 13 July '64 (*P. R. U.*); Provincetown, 25 June '04; Wellesley, 27 May '91 (*A. P. M.*).

Saldula confluens (Say).

Conn.— S. Meriden, 11 July '14 (*H. L. J.*).

Saldula orbiculata (Uhler).

Mass.— Cambridge; Cohasset, 12 Sept. (*O. B.*); Wellesley, 17 April '91 (*A. P. M.*).

Saldula interstitialis (Say).

Me.— Ft. Kent, 19 Aug. '10 (*C. W. J.*); Orono, 4 Sept. '85 (*H. T. F.*); Paris, 10 July '14 (*C. A. F.*).

N. H.— Hanover, 6 July '08 (*C. W. J.*); Mt. Washington, summit, 30 June '13 (*C. W. J.*).

Vt.— St. Albans, 21 June '13 (*C. W. J.*).

Mass.— Andover (*fide Uhler*); Beach Bluff, 18 Aug. '14 (*H. M. P.*); Cohasset, 15 Sept. (*O. B.*); Forest Hills, 1 June '15 (*H. M. P.*); Lynn, 7 Aug. '14 (*H. M. P.*); Nantucket, 20 July '10 (*J. A. C.*); Sherborn, 19 April '09 (*C. A. F.*); Wellesley, 10 Nov. '90 (*A. P. M.*).

R. I.— Buttonwoods, 18 June '12 (*C. W. J.*).

Conn.— E. Hartford, 13 Aug. '06 (*B. H. W.*); S. Meriden, 24 March '15 (*H. L. J.*); W. Stratford, 16 Aug. '04 (*H. L. V.*).

Saldula separata (Uhler).

Vt.— Montgomery, 18 July '91 (*A. P. M.*).

Saldula reperta (Uhler).
N. H.— Mt. Washington, summit (*fide Slosson*).
Mass.— Cambridge; Winchendon, 1 July '92 (*A. P. M.*).

Saldula xanthochila limbosa (Horváth).
Conn.— Branford, 11 Aug. '04 (*H. L. V.*).

Saldula pallipes (Fabricius).
Me.— Eastport, 15 July '09 (*C. W. J.*); Paris, 4 July '15 (*C. A. F.*).
N. H.— Mt. Washington, summit, 30 June '12 (*C. W. J.*).
Vt.— St. Albans, 21 June '13 (*C. W. J.*).
Mass.— Beach Bluff, 18 July '15 (*H. M. P.*); Manomet, 13 Aug. '12 (*W. S. B.*); Wellesley, 24 June '92 (*A. P. M.*).
R. I.— Tiverton, 31 July '10 (*N. S. E.*).
Conn.— W. Stratford, 16 Aug. '04 (*H. L. V.*).

Saldula sphacelata (Uhler).
Me.— Machias, 17 July '09 (*C. W. J.*).
Mass.— Beach Bluff, 21 June '15 (*H. M. P.*); Chatham, 30 June '04 (*C. W. J.*); Chelsea; Cohasset, 8 Sept. (*O. B.*); Edgartown, 29 June '12 (*C. W. J.*); Provincetown, 27 June '91 (*A. P. M.*).
R. I.— Buttonwoods, 25 July '11 (*C. W. J.*).

?Saldula opacula (Zetterstedt).
Me.— Orono, 4 May '14 (*H. M. P.*).
Mass.— Beach Bluff, 18 July '15 (*H. M. P.*).

Saldula pellita (Uhler).
Mass.— Chelsea, 9 July; Newtonville.

?Saldula saltatoria (Linné).
Mass.— Agawam, 21 April '16 (*H. E. S.*); Forest Hills, 11 April '15 (*F. X. W.*); Lexington, 19 April '74 (*E. B.*); W. Springfield, 7 April '16 (*H. E. S.*).
R. I.— Providence, 1 Feb. (*C. A. D.*).
Conn.— Lyme, 30 April '11 (*A. B. C.*).

Micracanthia humilis (Say).

N. H.— Mt. Washington, summit (*fide Slosson*).

Vt.— Norwich, 8 July '08 (*C. W. J.*).

Mass.— Beach Bluff, 18 July '15 (*H. M. P.*); Forest Hills, 1 June '15, 30 Sept. '15 (*H. M. P.*); Manomet, 27 July '05; W. Cambridge.

NOTONECTIDAE.

Notonectinae.

Notonecta irrorata Uhler.

Me.— Machias; Norway (*S. J. S.*); Orono, 22 May '14, 19 Sept. '13 (*H. M. P.*).

N. H.— Crawfords, 23 Sept. '16 (*H. M. P.*); Durham, 15 Aug. '00 (*W. F. F.*), 18 Sept. '01.

Vt.— Winooski, 30 Aug. '01 (*C. A. D.*).

Mass.— Amherst; Brookline, 17 Nov. '79 (*S. H.*); Forest Hills, 29 April '16 (*H. M. P.*); Peru, 27 Aug. '04 (*J. B.*); Saugus (*F. W. D.*).

R. I.— (*Davis Coll.*).

Conn.— Hamden, 24 April '11 (*B. H. W.*); New Haven, 24 Nov. '10 (*A. B. C.*); Windsor, 26 July '05 (*W. E. B.*).

Notonecta uhleri Kirkaldy.

Mass.— Wellesley, 12 Sept. '98, 22 Oct. '02 (*A. P. M.*).

Notonecta variabilis Fieber.

Me.— Durham, Aug. '99 (*O. O. S.*); Orono, 19 April '14 (*H. M. P.*), 15 Sept.

N. H.— Crawfords, 23 Sept. '16 (*H. M. P.*); Durham (*C. M. W. & W. F. F.*); Holderness, 3 Aug. '99 (*A. P. M.*).

Vt.— Woodstock, 13 Aug. '10 (*A. P. M.*).

Mass.— Forest Hills, 29 April '15, 8 Oct. '14 (*H. M. P.*); Saugus (*F. W. D.*); Sherborn, 14 April '99 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, 5 May '08, 11 Nov. (*J. B.*).

CONN.— Hamden, 24 Oct. '10 (*B. H. W.*); Hartford, 13 Aug. '04 (*H. L. V.*); New Haven, 22 Aug. '04 (*P. L. B.*); S. Meriden, 27 March '14 (*H. L. J.*).

Notonecta undulata[1] Say.

ME.— Orono, 20 April '12, 19 Sept. '13 (*H. M. P.*).

N. H.— Crawfords, 23 Sept. '16 (*H. M. P.*); Durham, 4 Oct. '01; Mt. Washington, Lake of the Clouds, 5000 ft., 1 July (*C. A. F.*); N. Chatham, 17 Sept. '06.

VT.— Winooski, 30 Aug. '04 (*C. A. D.*).

MASS.— Amherst, 26 Aug. '04; Forest Hills, 23 Feb. '15, 15 Oct. '14 (*H. M. P.*); Peru, 27 Aug. '04 (*J. B.*); Woods Hole, July (*T. H. M.*).

R. I.— Kingston, Sept. '07 (*J. B.*).

CONN.— Hamden, 24 Oct. '10 (*B. H. W.*); Southington, 21 April '10 (*B. H. W.*); S. Meriden, 5 April '14 (*H. L. J.*).

Notonecta insulata Kirby.

ME.— Orono, 27 April '13 (*H. M. P.*).

N. H.— Mt. Washington, Lake of the Clouds, 5000 ft., 1 July (*C. A. F.*).

MASS.— Amherst; Blue Hills, 11 April '14; Forest Hills, 29 April '15 (*H. M. P.*); Orleans, 13 Apr. '91 (*F. B.*); Peru, 27 Aug. '04 (*J. B.*); Saugus, 3 May '14 (*F. W. D.*); Wellesley, 1 Nov. '04 (*C. A. F.*).

R. I.— Kingston, 11 Nov. '09 (*J. B.*).

CONN.— Litchfield, 30 May '13 (*L. B. W.*).

Buenoa margaritacea Torre Bueno.

VT.— Woodstock, Aug. '09 (*A. P. M.*).

MASS.— Amherst; Forest Hills, 17 June, 15 Oct. '14 (*H. M. P.*).

Buenoa elegans (Fieber).

MASS.— Cambridge; Forest Hills, 30 Sept. '14 (*H. M. P.*); Wellesley, 4 Nov. '01 (*A. P. M.*).

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[1] Including the varieties, *undulata* Say, *maculata* Fieber, *charon* Kirkaldy, and intergrading forms.

PLEINAE.

Plea striola Fieber.

MASS.— Cambridge, 11 April '08 (*J. A. C.*); Fall River, 17 May '06 (*N. S. E.*); Wayland, 14 May '02 (*A. P. M.*); Wellesley, 6 May '03 (*A. P. M.*).

NAUCORIDAE.

NAUCORINAE.

Pelocoris femoratus (Palisot de Beauvois).

MASS.— Forest Hills, 10 Oct. '14 (*H. M. P.*); Groton, 11 Oct. '00 (*F. B.*); Quincy, 21 Oct. '05; Sandwich, 19 June '08 (*C. W. J.*); Wellesley, 7 Oct. '02 (*A. P. M.*); Woods Hole, July (*T. H. M.*).

R. I.— Providence, May '07 (*C. A. D.*); Warwick.

CONN.— Cheshire, 6 May '11 (*B. H. W.*); S. Meriden, 20 March '14 (*H. L. J.*).

NEPIDAE.

Nepa apiculata Uhler.

N. H.— Durham, 20 Oct. '01.

MASS.— Amherst, 5 Sept. '05; Boston (*A. P. M.*); Danvers, 30 May; Framingham, 21 May '07 (*C. A. F.*); Milton, 15 May '26 (*Harris Coll.*); Nantucket, '59 (*S. H.*); Newton, 30 Dec. '01 (*C. A. F.*); Salem.

R. I.— Kingston (*J. B.*); Providence, 15 July '94 (*C. A. D.*).

CONN.— New Haven, 11 Aug. '08, nymph (*B. H. W.*).

Ranatra kirkaldyi Torre Bueno.

MASS.— Cambridge; Dover, 23 Oct. '01 (*A. P. M.*); Framingham, 2 May '15 (*C. A. F.*).

Ranatra americana Montandon.

ME.— Orono, 4 Oct. (*H. M. P.*).

N. H.— Hanover (*C. M. W.*).

MASS.— Amherst, 26 Aug. '04; Forest Hills, 23 April, 15 Oct. '15 (*H. M. P.*); Wellesley, 20 April '91 (*A. P. M.*).

Ranatra protensa Montandon.

Mass.— Chebacco Lake, 13 Sept. '12 (*W. S. B.*); Framingham, 2 May '15 (*C. A. F.*); Taunton, 23 May '27 (*Harris Coll.*).

BELOSTOMATIDAE.

Benacus griseus (Say).

Mass.— (*fide Uhler*).

R. I.— Peacedale, Aug. '06; Providence, July '07 (*C. A. D.*).

Conn.— New Haven, 22 May '11 (*A. B. C.*).

Lethocerus americanus (Leidy).

Me.— Auburn, 18 June (*O. O. S.*); Orono, 12 Sept.; Oldtown, 8 May.

N. H.— Raymond, 27 June '14 (*W. R.*).

Mass.— Amherst; Cohasset, 26 April '07 (*O. B.*); Fall River, 20 Sept. '06 (*N. S. E.*); Forest Hills, 10 Oct. '15 (*H. M. P.*); Wellesley, 24 Oct. '04 (*A. P. M.*).

R. I.— Kingston, 23 May '08 (*J. B.*); Providence, 2 June (*C. A. D.*).

Conn.— Lyme, 4 Sept. '09 (*C. H. D.*); New Haven, 27 March '05 (*P. L. B.*).

Lethocerus obscurus (Dufour).

Mass.— Amherst; Cambridge, Sept. (*Harris Coll.*); Lowell (*F. B.*) (*fide Montandon*).

Conn.— Torrington (*R. H.*).

Belostoma flumineum Say.

Me.— Auburn (*E. D. M.*); Orono, 20 June, 17 Oct.; Wales, 10 July '13 (*C. A. F.*).

N. H.— Durham, 25 Oct. '01; Hanover (*C. M. W.*).

Vt.— Winooski, 30 Aug. '01 (*C. A. D.*).

Mass.— Amherst, 26 Aug. '04; Boston, 29 March '03 (*H. M. P.*); Forest Hills, 1 Nov. '15 (*H. M. P.*); Saugus, 10 May '14 (*F. W. D.*); Wellesley, 16 May '99 (*A. P. M.*).

R. I.— Kingston, Sept. (*J. B.*); Providence, 2 June (*C. A. D.*).

Conn.— New Haven, 22 Aug. '13 (*B. H. W.*); S. Meriden, 3 April '14 (*H. L. J.*).

Belostoma lutarium (Stål).

Mass.— Boston, 22 March '03, nymph (*H. M. P.*); Dover, 23 Aug. '01, nymph (*A. P. M.*); Falmouth (*fide T. H. M.*); Melrose, 11 July, nymph (*F. W. D.*); Tyngsboro, 16 Aug. '90 (*F. B.*); Wellesley (*A. P. M.*).

R. I.— (*fide Kirkaldy and Torre Bueno*).

OCHTERIDAE.

Ochterus americanus (Uhler).

Mass.— ?Amherst; Dedham, April (*F. G. S.*) (*fide Uhler*).

CORIXIDAE.[1]

Arctocorisa interrupta (Say).

Me.— Orono, 21 April '00 (*O. O. S.*); 8 May '12 (*H. M. P.*).

N. H.— Durham, 1 Oct. '01 (*W. F. F. & C. M. W.*).

Vt.— Winooski, 30 Aug. '01 (*C. A. D.*).

Mass.— Amherst, 30 Aug. '04; Forest Hills, 16 Mar. '15, 1 Nov. '15 (*H. M. P.*); Marblehead, 8 Aug. '14; Nonamesset Id., 7 July '11 (*J. F. A.*); Peru, 21 Aug. '04 (*J. B.*).

R. I.— Kingston, 11 Nov. '09 (*J. B.*); Providence, 18 June (*C. A. D.*).

Conn.— Fairfield, 15 July '04 (*H. L. V.*); Hamden, 24 Oct. '10 (*B. H. W.*); Southington, 21 May '10 (*B. H. W.*); South Meriden, 19 Mar. '13 (*H. L. J.*).

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[1] Prof. J. F. Abbott, who is engaged on a monograph of the Corixidae, has gone over all my material in the family, generously putting at my disposal the results of considerable labor.

Arctocorisa nitida (Fieber).
Me.— Orono, 24 April '13 (*H. M. P.*).
N. H.— Durham, 20 Sept. '01.
Mass.— Forest Hills, 4 May '15 (*H. M. P.*).
R. I.— Providence, 13 Sept. (*C. A. D.*).
Conn.— New Haven, 22 June '12 (*A. B. C.*).

Arctocorisa kennicotti (Uhler).
Me.— Orono, 21 April '00 (*O. O. S.*).
N. H.— Durham (*W. F. F.*).
R. I.— Kingston, 8 May '08 (*J. B.*).
Conn.— Hamden, 1 June '11 (*B. H. W.*); S. Meriden, 27 Mar. '14 (*H. L. J.*).

Arctocorisa lucida Abbott.
Ent. News, 1916, vol. 27, p. 341.

N. H.— Durham, 4 Oct. '14.
Mass.— Forest Hills, 4 May '15 (*H. M. P.*).
Conn.— Cheshire, 6 May '11 (*B. H. W.*); Hamden, 1 June '11 (*B. H. W.*); New Haven, 22 Aug. '13 (*B. H. W.*).

Arctocorisa ornata Abbott.
Ent. News, 1916, vol. 27, p. 341.

Me.— Orono, 19 April '14 (*H. M. P.*).
Conn.— Cheshire, 20 June '11 (*B. H. W.*).

Arctocorisa decorata Abbott.
Ent. News, 1916, vol. 27, p. 341.

Mass.— Amherst, 26 Aug. '04.

Arctocorisa dubia Abbott.
Ent. News, 1916, vol. 27, p. 342.

Me.— Orono, 20 July '05.
Mass.— Peru, 27 Aug. '04 (*J. B.*).

Arctocorisa alternata (Say).

Me.— Orono, 19 April '14 (*H. M. P.*); Pownal, 13 Oct. '00 (*O. O. S.*).

N. H.— Durham, 13 Aug. '00 (*W. F. F.*).

Mass.— Amherst, 7 May '04; Forest Hills, 1 Nov. '15 (*H. M. P.*).

R. I.— Kingston, 11 Nov. '09 (*J. B.*).

Conn.— Hamden, 24 April '11 (*B. H. W.*); New Haven, 22 June '10 (*A. B. C.*).

Arctocorisa parshleyi Abbott.

Ent. News, 1916, vol. 27, p. 342.

Me.— Orono, Sept.; Mercer.

Mass.— Lynn, 1 July '01 (*C. A. D.*).

R. I.— Providence, 18 June (*C. A. D.*).

?Arctocorisa trilineata (Provancher).

Me.— Orono, 10 May '13 (*H. M. P.*); Paris, 7 April '15 (*C. A. F.*).

N. H.— Durham, 20 Sept. '01.

Mass.— Saugus, 22 Oct. '14 (*H. M. P.*).

R. I.— Kingston, 3 May '08 (*J. B.*).

Arctocorisa compressa Abbott.

Me.— Orono, 19 April '12 (*H. M. P.*).

Mass.— Forest Hills, 29 April '15 (*H. M. P.*).

Conn.— Hamden, 1 June '11 (*B. H. W.*).

Arctocorisa seriata Abbott.

Ent. News, 1916, vol. 27, p. 342.

Me.— Orono, 19 April '14; Pownal, 13 Oct. '00 (*O. O. S.*); Paris, 7 April '15 (*C. A. F.*).

N. H.— Durham, 20 Sept. '01 (*C. M. W. & W. F. F.*).

Mass.— Peru, 27 Oct. '04 (*J. B.*).

R. I.— Kingston, 2 May '04 (*J. B.*).

Conn.— Cheshire, 20 Mar. '11 (*B. H. W.*); Hamden, 21 Oct. '10 (*B. H. W.*); New Haven, 6 May '04 (*H. L. V.*).

Arctocorisa scabra Abbott.
Me.— Orono, 28 April '12 (*H. M. P.*).
N. H.— Durham, 20 Oct. '01.
Mass.— Lynn, July '01 (*C. A. D.*).
R. I.— Providence, 18 June (*C. A. D.*).
Conn.— Cheshire, 20 Mar. '11 (*B. H. W.*); New Haven, 18 Mar. '11 (*B. H. W.*).

Corixa verticalis Fieber.
Mass.— Beach Bluff, 19 July '15 (*H. M. P.*).
R. I.— Kingston (*J. B.*).
Conn.— Branford, 28 Aug. '05 (*H. M. W.*); East River, 2 Aug. '00 (*C. R. E.*).

Callicorixa praeusta (Fieber).
Me.— Orono, 17 May '13 (*H. M. P.*).

Palmacorixa buenoi Abbott.
Mass.— Hadley (*C. A. F.*).

Addendum.

TINGIDAE.

Corythucha salicis Osborn and Drake.
Ohio Journ. Sci., 1917, vol. 17, p. 298.

Mass.— Middlesex Fells.

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HOLOLEPTINÆ OF THE UNITED STATES

BY

F. G. CARNOCHAN

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HOLOLEPTINÆ OF THE UNITED STATES.*

By F. G. CARNOCHAN.

SECTION I.

The Hololeptinæ in the United States comprise the genera *Hololepta*, subdivided into *Hololepta* and *Leionota* and *Iliotona* (n. gen.). The name Leionota, amended to Lionota by Marseul, requires comment. *Leionota* was proposed by Dejean as a genus of Histeridæ in the so-called first edition of his catalogue in 1821 (really the second); this division was retained in his catalogues of 1833 (the date usually assigned to the name), and 1837. Under this name he cited several species of which only two *Hololepta quadridentata* Fab. and *H. lamina* Payk. were described species; this citation would ordinarily fix the genus with one of the included described species as type, but Marseul in 1853 pointed out, after a study of the Dejean collection, that the species assigned by Dejean to *quadridentata* Fab. was not that species, but another which he described as *devia*, and that the species *lamina* was not Paykull's species but *minuta* of Erichson. The mere fact that the specimens which Marseul saw were misidentified does not invalidate the name. We have only published records to go by, and misidentification cannot be absolutely proved. Marseul in 1853 used the name *Leionota* for the same division, and in 1857 changed it to Lioderma. The name of the subgenus should therefore be Leionota and is ascribed to Dejean with a date of 1821 with *Leionota quadridentata* Fab. as type, as one of the forms included in the original citation, the name *Lioderma* becomes a synonym.

The life history and habits of the members of this subfamily are very little known. The egg is unknown, but probably closely resembles the eggs of the members of the other subfamilies; I have figured the egg of *Hister obtusatus* Harris (Pl. XXX, Fig. 3). This egg is similar in shape and appearance to the eggs of *Saprinus* and *Hetærius*, white, opaque and minutely roughened, about two millimeters long. Examination of the ovaries of various Histerids, and observations show that the eggs are ripened one at a time and are laid at appreciable intervals of time; in the genus Hister the interval varies from three to eight days, in Saprinus it is less, usually about one day. I append figures of the ovaries of *Hister obtusatus* Harris, *Saprinus pennsylvanicus* Payk. (Pl. XXX, Figs. 4-5), which show the periodic ripening of the eggs. The early stages of the larva are not known, but the last stage of Hololepta æqualis Say may be briefly described as follows:

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*Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 134.

Hololepta æqualis Say. Plate XXVIII, XXIX.

Larva. Wickham. American Naturalist, XXVIII, p. 816, 1894.

Length 14-16 mm. Flattened, white.

Head strongly chitinized, quadrate, chestnut brown. Dorsally, with a shallow transverse impression about one-third from the anterior margin to the posterior border, two punctures on this impression, behind them and out side of them two more, and behind these two and inside of them two more, a line connecting all these punctures would form an almost regular octagon; behind each antenna and forming the arc of a circle with the center towards the antennæ, three punctures. Clypeus quadrate, broader than long. Antennæ inserted posterior to the mandibles at the anterior corners of the head,* first external segment long, cylindrical, second a little more than half the length of the first, dilated at apex; third short, half the length of the second, narrowly cylindrical, the whole antenna almost as long as the head. Mandibles stout, curved, with a stout tooth a little more than halfway from the apex, on the inner margin; when closed the left mandible overlaps the right. Ventrally, the head has behind the labium a cordate shaped impression, at the anterior margin of which there is a boss, another boss occurs near the base, and connected to this impression at the base there is a deep spear-shaped puncture; near the lateral borders on a line with this puncture there is on each side a shallow puncture. Maxillæ inserted at the base of the mandible near the interior border, the dorsal surface of the first visible segment concave longitudinally; inner margin of the same segment fringed densely, outer margin lightly fringed and with a single long bristle on the apical fourth, second segment the

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*Dissection shows the antenna to be inserted on a process next to the superior external basal corner of the mandibles, the true first joint. The antenna has four true joints.

length of first, one quarter the length of first, with a short segment on the inner margin which bears a single bristle. Third and fourth segments together a little longer than the second, and equal in length to the fifth, third segment slightly shorter than fourth. Labium with two jointed palpi, the first joint of which is half the length of the second. Pronotum as large as head, corneous with a deep median longitudinal furrow, the center portion, triangular, the base of the triangle towards head, deep chestnut brown, remainder light brown, a single bristle on each side before the middle. Prosternum corneous with seven differentiated areas, the center one triangular, with the apex of the triangle towards the head, yellow brown; on each side of this center area, a triangular area whose base is towards the head, of the same color, outside of this a rhomboidal area of lighter color, and posterior to the rhomboidal area, a white area which carries the coxæ.

Meso- and metathorax short, one-third the length of the prothorax. Mesonotum colored for its entire width, metanotum with a broad band for almost the entire width, and a smaller area at each edge, sternites with three markings; a broad band across the center to the lateral halves, and at each end of this band a smaller area, all colored light brown. Each segment with a single marginal bristle.

Nine abdominal segments are present, the first with two complete transverse rows of ambulacral hooks dorsally, and between each row the same arrangement of colored patches in threes as on the metathorax. All the remaining segments, except the ninth which bears none, have three rows of hooks, and between each row the same arrangement of plates. On the fold between the segments, on each side between the center and the lateral colored areas, there is a small group of hooks arranged in the arc of a circle whose center lies posterior; behind the last rows of hooks on the segments themselves and directly anterior to the small group mentioned above there is a single seta with a few hooks around it. Ninth segment with a pair of cerci, each composed of a basal tubercle which bears a single bristle, a first segment which is stout and clavate with a pair of stout bristles below the insertion of the second segment which is one and one-half times as long as the first segment, and half as wide, and bears at its apex a pair of strongly diverging bristles. On the lateral margins of the abdominal segments are paired bristles, rising from tubercles, and on all the segments except the first there is, under the first of these bristles, another stout bristle on all the segments except the ninth where it is reduced in size and comes under the posterior bristle of the two, on the ventral surface. On the ventral surface each segment bears three rows of ambulacral hooks except the ninth which has none, and the eighth which has two complete rows, the first row broad and entire, the second short, interrupted at middle, the third entire and forked at each end. The ninth segment has the anal region developed into a pseudopod. Spiracles biforian, on the mesothoracic, and all abdominal segments except the ninth. Legs composed of a cylindrical coxa, which bears two bristles on its inner margin, a trochanter, cylindrical, short, a femur three times as long as the trochanter, a tibia two-thirds the length of the former and a claw; the claw bears a short accessory spine (visible only at high magnifications).

I am unable to see under the highest magnification the rudimentary tarsus which Schiodte (1864) figures. The spine on the claw resembles the figure given by Schiodte for *Platysoma depressum.* These larvæ have great difficulty in crawling unless they can bring the dorsum into contact with something. The hooks, which in the description I called "ambulacral," are used by the larva to push itself along. The larva, in moving, draws up the anal pseudopod and places it; then the segments move forward in rhythmical order, the hooks serving to attach each segment while the next one in front of it is moving forward. The larvæ are very voracious carnivores, living on the larvæ of an anthomyid fly, and an ortalid fly, eating from six to fifteen a day.

When the larva is full grown it sets itself to work to make the pupal cell, travelling as much as an inch for material, shredded wood, cotton, filter paper, anything available which it can chew up; the natural material is finely chewed wood. The wood is cemented together with an anal secretion, and it is not uncommon to see the larva reach to its anus with its head and apply the secretion gathered to the wall of its cell. I believe that the clypeus and frons are used for carrying the secretion and the clypeus and mandibles used as trowels to spread it. The larva begins by forming a ridge of transported material, then adds to the cell by adding pieces to each side of the ridge. These are laid near the position desired and pushed into place with head and mandibles. Every little while the animal stops transporting material, wets the whole mass, pushing it into place with head and body. The last portion of the pupa case to be finished is the anterior end in which a small hole, through which the larva reaches its materials, is left till the last and is then plugged and cemented rather loosely. In one case the hole was not plugged at all, but remained open after the larva had assumed the prepupal position. When the cell is complete, the larva closes the open end and gives the entire inside of the cell a coating of the anal secretion, which is colorless when first applied, but rapidly becomes very dark brown; it then orients itself so that the head end of the pupa shall be opposite the loosely plugged opening; and takes a peculiar prepupal position. The body shortens slightly and the head is bent over and applied to the venter; this fold occurs at the suture between the metathorax and the abdomen. The time taken to become an immobile prepupa is about eighteen hours. The prepupal stage lasts seventeen-eighteen days; but the day before pupation takes place the prepupa raises the head and thorax slightly. The thorax then splits down the back and the pupa emerges.

Pupa: Length 8-10 mm. Color varying with age, but general appearance white. Imago visible through the transparent pupal skin. Spiracles on the second, third, fourth and fifth epipleurites. Genitalia extruded. On the pronotum, an irregular band of fifteen bristles extending distant from the margin along the lateral margin of the thorax to the hind margin half way from center to margin, and an inner row of three bristles. Elytra with scattered bristles, which are definite in number and location. (Pl. XXX, Figs. 1-2). Second, third, fourth, epipleurite each with a stout spine. First and second abdominal tergite with a pair of bristles, third with seven bristles (arranged in a triad and two pairs) each side of middle, fourth with two pairs and fifth with one pair each side of the median line. Propygidium and pygidium fringed with bristles. This chætotaxy is definite in the four specimens before me.

At the end of the second day after pupation the eyes are colored, by the eighth day the median line of the mesosternum and the median line and segment lines of the abdominal tergites are colored. Pigmentation then commences on the pronotum and after twenty days the pronotum is fully colored. Emergence takes place at the end of from twenty-four to twenty-nine days. In one case emergence started at eight fifty-five in the morning, was completed except for the withdrawing of the genitalia at eleven fifteen, and was fully completed at twelve twenty-five. The adult does not become completely colored for three days after emergence.

NOTES ON THE MORPHOLOGY OF LARVA, *H. æqualis*, LAST STAGE. (Plates XXVIII, XXIX, XXX).

Head: Cranium (Figs. 5, 6, 7) symmetrical, rectangular, a little broader than long; occipital foramen narrower than the cranium and almost directly posterior, the head reaches slightly further back below than above; ventral surface with genal sutures (Fig. 6) apparent in the posterior portion. Labrum (Fig. 3) very rudimentary and slightly differentiated from the clypeus, not movable. Clypeus firmly united to frons, epistoma not distinct. Epicranial and frontal sutures not visible in living larvæ, though slightly visible in moult skins. Antennæ (Figs. 5, 6, 7) deeply inserted in the head. Above the dorsal articulation of the mandible, composed of four segments, the first very short, hardly visible externally, the second long cylindrical, the third capitate, a little more than half as long as the second, the fourth very small, cylindrical, the third joint with a sensory pit at the tip near the external margin, and one to three papillæ near the apex on the internal margin.

Mandible (Figs. 5, 6, 7) falciform, acute, with a single rounded tooth on the inner margin. At the base of the internal margin a cluster of setæ.

Maxillæ (Fig. 7) connected with hypostoma by a thin membrane. Cardo very small, almost completely concealed; a flat plate on the external border of the maxilla and fused to the stipes. Stipes, a long tubular segment, densely fringed with hairs on the inner margin, sparsely fringed on the outer margin, with a long tactile seta near the distal end, inserted just above the margin. The stipes are flattened on the dorsal side. Next to the stipes come a stout short segment, less than one-quarter the length of the stipes. It is swollen on the inner side and bears on the swelling a short finger-like segment, which has a sensory bristle at the tip. The swollen segment probably represents subgalea and palpifer fused; the finger-like segment is probably galea. At the apex of this swollen segment is a three-jointed palpus. The second and distal segments of the palpus have numerous sensory pits on the surface.

The mentum is coriaceous, colored only on the margins; it is closely united to the submentum, which is slightly chitinized and light brown in color. The palpifers are fused and form a hollow tube, bearing two jointed palpi at the distal end. No ligula or paraglossæ are present. Above the labium lies the hypopharynx. This has two blades, visible in Fig. 7, which bear numerous bristles on the margin. Limiting the hypopharynx on each side is the hypostoma, which extends as a heavily chitinized rod upwards from the base of the mouth cavity, a flattened bridge, the epipharyngeal bracon (Fig. 7), extends between the two rods below the epipharynx (Fig. 3).

The thoracic segments are sharply differentiated from the abdominal. Pronotum consists of a heavily chitinized scutum, a less heavily chitinized parascutum. The meso- and metathorax show the scutum above. The first abdominal segment has a prescutum, a scutum and postscutum, the remaining abdominal segments have the scutum divided into two parts by a line of ambulacral hooks (reptoriæ Schiodte). On all the segments except the prothorax the pleuræ are readily distinguishable. On the dorsal side they are limited by muscle marks and on the ventral side there is a distinct sterno-pleural groove. The pleuræ are divided into epi- and hypopleuræ by the pleural suture. The epipleura of all the segments except the pro- and metathorax bears a biforian spiracle, and a bristle, the hypopleura bears also a single bristle. Prosternum consists of a triangular sternum and two plates on each side of it. The inner one is the parasternum, the outer is pleural in origin. The abdominal sternites show a presternum, a sternum which is cut off from the presternum by a muscle groove and a sternellum which is separated from the other two plates by a row of ambulacral hooks. The ninth abdominal segment bears an anal pseudopod, which I believe to be a tenth segment.

EXPLANATION OF PLATES—SECTION I.

PLATE XXVIII.

Fig. 1. Dorsal view of the larva of Hololepta æqualis Say.
Fig. 2. Ventral view of the larva of Hololepta æqualis Say.
Fig. 3. Underside of the clypeus showing the epipharynx (larva of H. æqualis).

PLATE XXIX.

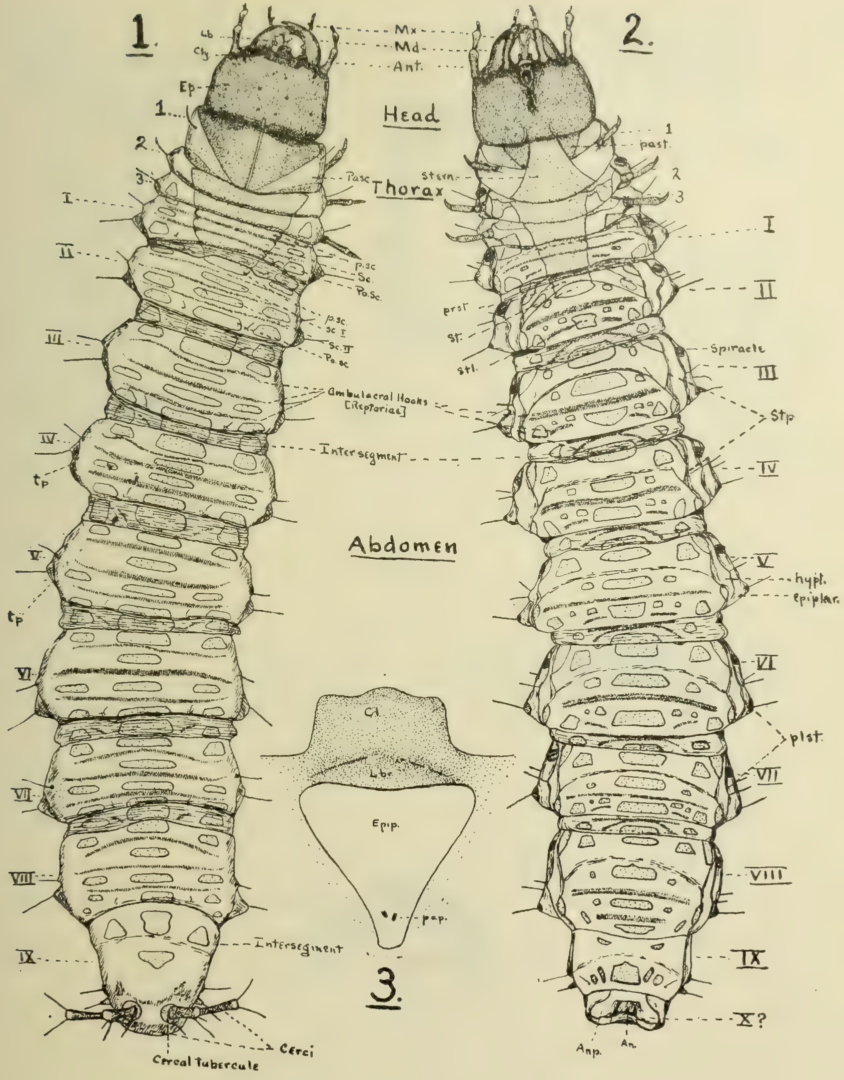
Fig. 4. Lateral view of the larva of H. æqualis.
Fig. 5. Dorsal view of cranium.
Fig. 6. Ventral view of cranium.
Fig. 7. Half front, half ventral view of mouth. Hypostoma and epipharyngeal bracon shown in stipple.

PLATE XXX.

Fig. 1. Ventral view of the pupa of H. æqualis.
Fig. 2. Dorsal view of same.
Fig. 3. Egg of Hister obtusatus Harris. × 12.
Fig. 4. Ovaries of Saprinus pensylvanicus Payk.
Fig. 5. Labium of *H. æqualis*.
Fig. 6. Ovary of Hister obtusatus Harris.

EXPLANATION OF TERMS USED ON PLATES XXVIII—XXIX.

Mx—Maxillae.
Md—Mandibles.
Ant—Antennae.
Lb—Labium.
Cly—Clypeus.
1, 2, 3—Thoracic segments.
I–IX—Abdominal segments.
Pasc—Parascutum.
p. sc—Prescutum.
sc—Scutum.
po. sc.—Postscutum.
past—Parasternum.
prst—Presternum.
st—Sternum.
stl—Sternellum.
stp—Sterno-pleural fold.
plst—Pleural suture.
hypl—Hypopleurite.
epipleur—Epipleurite.
Lbr—Labrum.
Epip—Epipharynx.
pap—Papillae.
F—Frons.
Epic—Epicranium.
Ge—Genae.
lbp—Labial palpus.
Palpig—Palpiger.
Buc. Op—Buccal opening.
hyph—Hypopharynx.
hypst—Hypostoma.
pleur—Pleurostoma.



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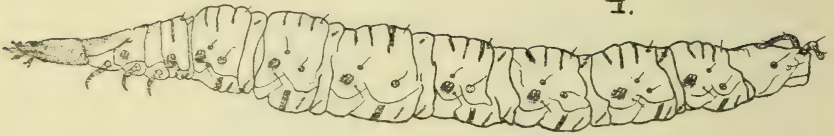

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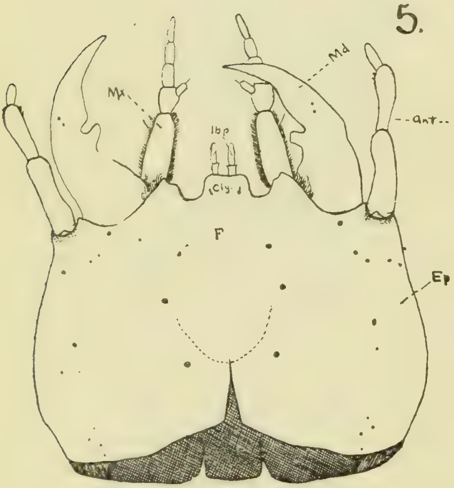

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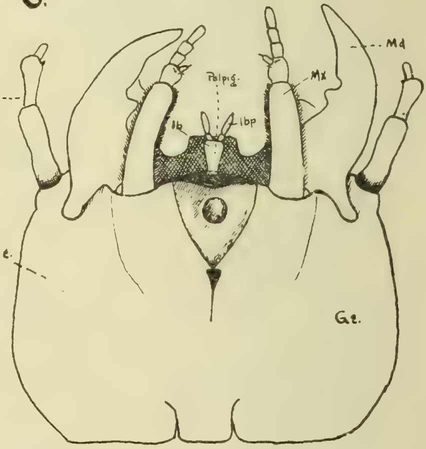

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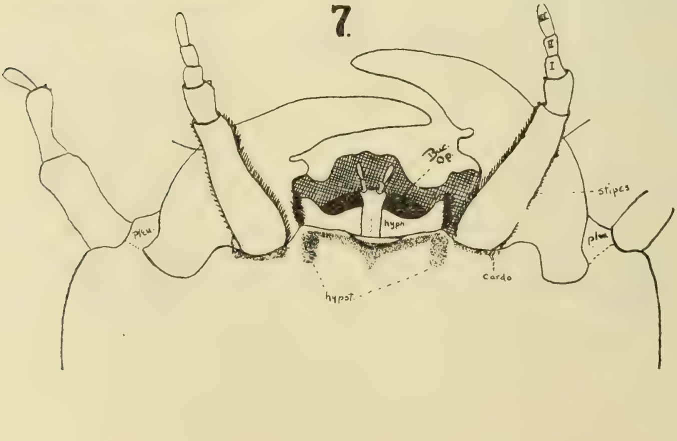

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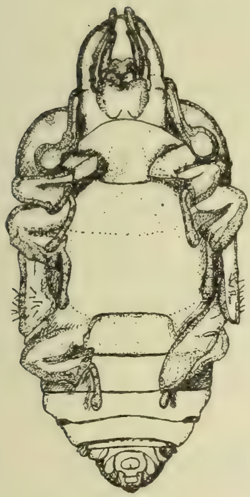

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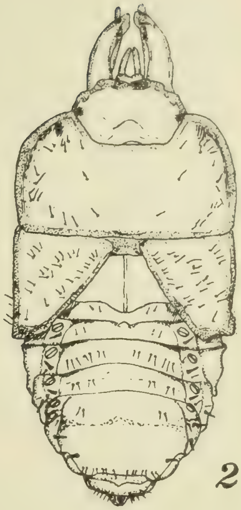

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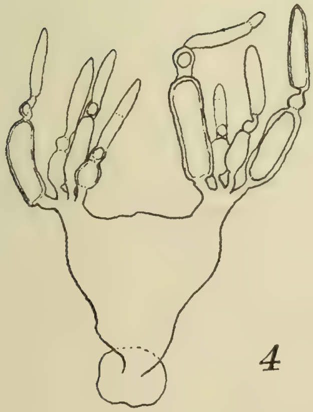

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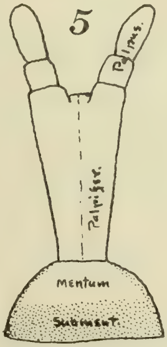

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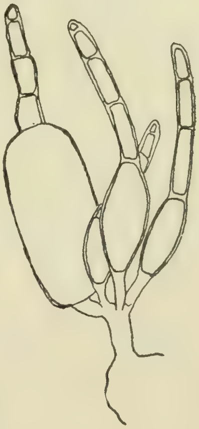

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SECTION II.

The species of *Hololeptinæ* are all black, elongate and more or less flattened, with a large projecting head which is more or less retractile, but not depressible; the mandibles are long and projecting, subequal and not crossing, except in *Oxysternus*, in which the left mandible is longer than the right and crosses it when closed. Labrum short, arcuate on each side of the median notch, viewed from above; excavated in front from below; closes the mouth by being applied to the anterior edge of the mentum, into the emargination of which it exactly fits; the maxillæ are inserted behind the mentum, their palpi lying in grooves on the mandibles. The prosternum is unlobed, although in certain of the genus *Hololepta* there is an impressed line dividing the prosternum into two parts, the anterior of which simulates a lobe. The propygidium is horizontal, or slightly depressed.

KEY TO THE NORTH AMERICAN HOLOLEPTINAE.

Prosternum not carinate, rounded or truncate anteriorly. Teeth on middle and hind tibiae unequally spaced, the two lower arising from the same process, more distant from the upper than from each other. .Genus **Hololepta**
Prosternum flattened, broadly rounded anteriorly.........Subgenus **Hololepta**
Prosternum elevated, narrower at apex and often truncate. .Subgenus **Leionota**
Prosternum carinate, terminating apically in a sharp point. Teeth of hind and middle tibiae, rising from different processes, equally spaced, long, spiniform .... **Iliotona** n. g.

Genus **Hololepta** Payk.

Elongate, flattened. Head porrect, mandibles subequal. Tibiæ dentate, the anterior quadri-, posterior and intermediate tridentate, the two lower teeth of the intermediate and posterior tibiæ borne on the same process, closer to each other than to the upper tooth; on the intermediate tibiæ there is also, in some species, a small additional tooth at the base of the upper and middle crests.

SUBGENUS HOLOLEPTA.

Strongly depressed, elongate. Prosternum very broad and flat; anterior margin broadly rounded. A fovea-like impression behind the eyes; supraorbital stria entirely lacking. In our forms there is always a transverse line on the prosternum about one-third of the distance from apex to base.

KEY TO HOLOLEPTA.

1. Elytra without entire striae; prosternal apex slightly emarginate; lateral pronotal punctures sparse, indistinct or absent..........................2.
   Elytra with an entire stria; prosternal apex broadly and evenly rounded; lateral pronotal punctures coarse, in a distinct band...........**lucida** Lec.
2. Elytra without an apical appendix to second stria, tristriate; pygidial punctures large; inflexed portion of elytra not rugose; prosternum not punctate .... **aequalis** Say.
   Elytra with an apical appendix to the second stria, bi- or tristriate; pygidial punctures fine and sparse; inflexed portion of elytra slightly rugose; prosternum finely punctate..3.
3. Narrowly oblong, almost parallel; upper surface impunctate, (except under extreme magnifications); propygidium not bifoveolate......**populnea** Lec.
   More narrowly oblong than preceding; upper surface distinctly punctate with minute punctures; propygidium bifoveolate at apex...var. **punctata** nov.

Hololepta æqualis Say. Trans. Amer. Phil. Soc. V, p. 47. 1825.
fossularis Say. Trans. Amer. Phil. Soc. V., p. 47. 1825.
fossularis ♂ Mars. Mon. p. 147, t. 4, fig. 5. 1853.

Elongate, oblong, almost parallel. Front flat, smooth, without striæ; preocular tooth not prominent. Mandibles as long as the head (♂), slightly shorter (♀), stout. Pronotum very slightly bisinuate at base, with a median longitudinal stria half extending from base half way to apex; marginal stria strong, entire, slightly sinuate behind the middle; sides of pronotum distantly and sparsely punctate, distant from margin. Elytra the width of pronotum, narrowing slightly posteriorly; tristriate, the first stria about one-third the length of the elytra, the second about one-third the length of the first, the third a trace, sometimes barely visible; sub-humeral deep, almost reaching the base, abbreviated at apex on the apical sixth. Inflexed border of the elytra impunctate. Propygidium smooth on disk, laterally bordered with sparse, coarse punctures. Pygidium usually evenly, rather sparsely punctate, but occasionally varying to smooth at middle and apex. Mentum transversely concave (♂), slightly concave with the center raised (♀), sparsely punctate. Gula with a broad V-shaped excavation (♂), with a small impressed V (♀). Prosternum broad, apex truncate, margin slightly emarginate. Length (apex of thorax to apex of suture*) 5–6 mm.

Variant forms. Three specimens in my series vary from the typical form by the presence of a very short apical appendix to the first stria.

New York to Michigan and Eastern Kansas, south to Florida, Texas and Louisiana.

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*This system of measuring, which gives a constant measure, and is not affected by the retractility of the head and propygidium, will be used throughout this paper.

The amount of punctation on the margins of the thorax varies from a very few distant punctures to an appreciable number, always, however, distant from the lateral margin.

The males may be readily distinguished from the females by the large fossa at the anterior angles of the thorax.

This species occurs under the bark of dead *Liriodendron* and is reported by Marseul to occur under the bark of *Robinia pseudo-acacia*.

It is rather unfortunate that the name *æqualis* must be substituted for the well-known name *fossularis*, but our present laws of nomenclature take cognizance of page priority and the name *æqualis* stands first on the page. Marseul, who first detected the fact that *æqualis* and *fossularis* were opposite sexes of the same species used the male name as was the custom at that time, but in this case also the International code is definite and the earlier name must be used.

Hololepta lucida. Leconte, J. Mon. p. 7, pl. 1, fig. 2. 1845.
Marseul, Mon. p. 177, pl. 4, fig. 18. 1853.

Elongate oblong, almost parallel. Front flat, without striæ; preocular tooth not prominent. Mandibles as long as head (♂) or slightly shorter (♀), stout. Pronotum very slightly bisinuate at base, with a median longitudinal stria extending half way from base to apex; marginal stria strong, entire, slightly sinuate behind the middle; distinctly punctate laterally in a broad band, in which the punctures often coalesce to form vermiform punctures. Elytra the width of the pronotum at base, slightly arcuate; tristriate usually, the first stria entire, the second short, with or without a short apical appendix, the third punctiform or absent; subhumeral abbreviated at base and apex. Inflexed border of elytra impunctate. Propygidium smooth on disk, laterally bordered with extremely coarse, sometimes vermiform punctures, bifoveolate at apex. Pygidium coarsely, densely punctate. Mentum transversely concave (♂), slightly concave with center elevated (♀), very finely, sparsely punctulate. Prosternum broadly evenly rounded at apex. Length 4.5–6 mm.

New York to Southern Illinois, south to Virginia.

The form with the short apical appendix to the second stria is the form described by Leconte. The males may be recognized by the fossa in the anterior angles of the thorax.

Reported by Blatchley (1910) under cotton wood bark.

Hololepta populnea Leconte. Ann. Lyc. N. York, V., p. 163. 1851.
bractea Er. Marseul. Mon. p. 157, t. 4, fig. 15. 1853 (in error).
populnea Marseul. Mon. p. 562, pl. II, fig. 5. 1850.

Narrowly oblong, nearly parallel. Front without striæ, preocular tooth short. Mandibles as long as the head (♂) or slightly shorter (♀). Pronotum bisinuate at base, with a more or less lightly impressed median stria, extending half way from base to apex; marginal stria entire, strong slightly sinuate behind middle, or interrupted or with the entire posterior half lacking. Elytra the width of pronotum at base, parallel; bi-or tri-striate, the first stria short, about one-third the length of elytra, second shorter, one-half the length of the first with a short apical appendix, third punctiform or absent; subhumeral stria deep, abbreviated slightly at base and apex. Inflexed border of elytra slightly rugose. Propygidium smooth on disk, extremely sparsely punctate laterally with deep punctures. Pygidium very finely and sparsely punctulate. Mentum concave (♂), less concave (♀), sparsely punctulate; gula with a broad V-shaped excavation, which has a short longitudinal carina at the base (♂) or with a small V-shaped impression (♀). Prosternum broadly emarginate at apex, finely punctulate. Length 3.5–5 mm.

Utah, Arizona, southern California and New Mexico.

Variants. The typical form as described by Leconte has the marginal stria of the thorax entire, and all the Leconte types have such a marginal stria; many of the specimens which I have examined have the stria more or less interrupted; in the extreme form the posterior half of the stria is absent; every possible intergrade is present in my series, even one in which the stria is broadly interrupted on one side and strong and entire on the other.

The length of the apical appendix also varies, in some it is extremely short and in one it is connected to the second by two punctures. The propygidial sculpture also varies, usually in proportion to the length of the apical appendix, but the correlation is not perfect.

One specimen agrees fairly well with Marseul's description of *H. bractea* Erichson in having the appendical stria directed towards the first stria and in pygidial sculpture. Marseul, in his first description (1853) of *bractea* reported it from the United States, and placed *populnea* in synonymy with it. He had at that time not seen the type of *bractea*. In a later description (1860) made after he had seen the type *bractea*, and had received specimens of *populnea* from Leconte, he states that the two species are distinct. I hesitate to assign the specimens above mentioned to *bractea*, because of the recorded variation in the punctation of the propygidium, and the fact that in size and facies the specimen is *populnea*.

The males may be distinguished by the notch in the anterior angle of the thorax, and the greater excavation of mentum and submentum.

Reported by Leconte (1851) under poplar bark; by Horn (1873) between the layers of cotton-wood bark.

Hololepta populnea var. **punctata** nov.

More narrowly elongate than *populnea*, almost parallel. Front without striæ, punctate with fine punctures, preocular tooth short depressed. Mandibles shorter than head (♀) (♂). Pronotum bisinuate at base, with a slightly impressed median stria extending half way from base to apex; marginal stria entire not strongly impressed, slightly sinuate behind middle, or interrupted; distinctly punctate with punctures of same magnitude as those on front and mandibles. Elytra the width of pronotum at base, narrowing slightly towards apex, bistriate, the first stria short, about one-third the length of the elytra, second half the length of the first, with an appendix in the apical third; subhumeral stria abbreviated at base and apex. Inflexed border of elytra slightly rugulose. Propygidium minutely, distantly punctulate on disk, laterally bordered with sparse larger punctures, which are larger than those of *populnea*, slightly bifoveolate apically. Mentum, gula and prosternum as in *populnea*. Length 4 mm.

Arizona, one male and one female. W. M. Mann. Sexes are differentiated as in *populnea*.

Hololepta (Hololepta) **excisa** Mars.

This species is recorded from the United States by Marseul. I have seen no specimens taken in the United States, and do not believe that this species occurs north of Mexico. It is reported from Mexico(Marseul, Biologia), Costa Rica (Biologia), Venezuela, New Granada, and Brazil (Marseul), I append an abstract of Marseul's description.

> Oblong, subdepressed, shining black. Front flat, without striae or tubercles. Pronotum punctate laterally, marginal stria scarcely angulate, well marked. The inflexed border of the elytra strongly rugose; subhumeral stria strong, rugose, a little abbreviated at base; dorsal striae two, rudimentary. Propygidium bordered with distant punctures. Pygidium densely and strongly punctate. Anterior tibiae armed with four blunt teeth; posterior with three long spines.

The males are characterised by the excavation of the mentum and the notch in the anterior angle of the pronotum.

Hololepta bractea Erichson, Klug's Jahrb. Ins., p. 91. 1834.
Marseul, p. 157, t. 4, fig. 15. 1853.
Marseul, p. 591 (t. 11, fig. 4). 1860.

In connection with the earlier description Marseul lists this species from the United States, because he had confused the species with *populnea* Lec. Lewis, in his Catalog of the Histeridæ (1905) cites this species from California, evidently on the strength of Marseul's first description, and makes no mention of Marseul's second description which refers the species to New Granada. Bickhardt in Junk's Catalogus Coleopterorum, *Histeridæ*, (1910) copying from Lewis, makes no change in the record or addition to the reference. I doubt the occurrence of this species in the United States.

Hololepta complanata P. deBeauv. Ins. Af. et Am., p. 176, t. 6, fig. 5, 1807.
Lew. Ann. Nat. Hist. XVI, p. 206. 1885.

Lewis and Bickhardt record this species as from North America, a form of citation which usually means north of Mexico. The species was recorded originally from Santo Domingo, and is unidentifiable in North American material.

SUBGENUS LEIONOTA.

Subdepressed, elongate. Prosternum elevated, more or less compressed laterally, narrowed, and anteriorly truncate or rounded at apex. Impression behind the eyes not distinctly limited; supraorbital stria usually visible at base.

The two subgenera of Hololepta are not very well limited, and in many cases a species might be placed with equal propriety in either.

KEY TO LEIONOTA.

1. Pronotum with a short impressed line on each side of the emargination at the apical margin, behind the eyes. Larger species........................2.
Pronotum without a short impressed line on each side of the emargination. Smaller species..4.

2. Broadly oblong. First and second elytral striae not continued towards scutellum along basal margin. Sternites of abdomen punctate at sides only. Lower crest of fore tibiae not dentate..............................3.
Narrowly oblong. First and second elytral striae continued along basal margin almost to the scutellum, this stria occasionally interrupted. Sternites of abdomen punctate throughout. Lower crest of fore tibiae dentate ....**pervalida** Blais

3. Pygidium densely and coarsely punctate. Usually with an appendix to the second elytral stria..**yucateca** Mars.

Pygidium finely punctate. Never an appendix to the second stria........ **princeps** J. Lec.

4. Sides of thorax moderately coarsely punctate. Mentum without an M-shaped excavation..5.

Sides of thorax impunctate. Mentum with an M-shaped excavation........7.

5. Front without strioles, or the strioles short, feeble and widely separated. Species broadly oblong..6.

Front with at least two closely approximated, long arcuate striae. Narrowly oblong..14.

6. Front without strioles. Larger 6.5–7 mm....................**vernicis** Casey.

Front with widely separated, short, feeble strioles. Smaller 5.5–6 mm. **sirpus** sp. nov.

7. Second dorsal stria of elytra interrupted in the basal third..**interrupta** Mars.

8. Elytra with a stria on the basal margin more or less deeply impressed, besides the two dorsal striae..9.

Elytra with but the two dorsal striae.......................**quadridentata. 10.**

9. Elytron with a deeply impressed, transverse stria along the basal margin equidistant from the second longitudinal stria and the scutellum...... **decimstriata** sp. n.

Elytra with an area, roughened by three longitudinal lines, between the second dorsal stria and the suture. From this area, a very faint finely impressed line extends along the base almost to the scutellum. On each side of the scutellum is a narrow, deep fovea............**bifoveolata** sp. n.

10. Front with two shallow foveae. Supraorbital stria long, reaching almost halfway to the tip of the preocular spine. Head extremely minutely punctulate* ....subsp. * **platysma** Er.

Front without foveae, supraorbital stria short..........................**11.**

11. Propygidium not at all, or extremely sparsely punctate on disk. Males with the thoracic fossa deep, and well marked..........................12.

Propygidium distinctly punctate on disk. Males with the thoracic fossa poorly developed and very shallow.......................subsp. **minor** nov.

12. Pygidium evenly punctate, the space enclosed by four punctures equal in size to a puncture. First elytral stria closer to the second than to the margin..13.

Pygidium unevenly punctate, the space enclosed by the four punctures being less than half the size of a puncture. First stria midway between second and margin....................................*subsp. **quadridentata**

13. Marginal stria of thorax without sinuation..............subsp. **floridae** nov.

Marginal stria of thorax with a shallow semi-circular sinuation just before the middle, and below this on the margin itself a short impressed line.. **floridae** var. **striatifera** nov.

14. Gula with a carina on each side extending backwards from the mandible, elevated in the anterior half, low and interrupted in the posterior half, the two carinae forming a V. Prosternum narrowly truncate at apex. **vicina. 15**

Gula without carinae, but with a Y-shaped groove. Prosternum broadly truncate, its anterior margin elevated and rugulose.............**caseyi** sp. n.

15. Larger 6 mm. Second, third and fourth abdominal sternites punctate for their entire width....................................subsp. **neglecta** Blaisd.

Smaller 4.5–5 mm. Second abdominal sternites punctate at sides only, third and fourth punctate in a narrow band across the middle of disk.....16.

16. Third elytral stria a puncture..............................**vicina** Lec.

Third elytra stria as long as the first..........**vicina** var. **californica** nov.

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*Denotes a form not occurring in the United States.

Hololepta (Leionota) princeps. Lec. J. Proceedings Acad. Nat. Sci. Phil., p. 310. 1859.

Marseul, Mon., p. 605. 1860.

Horn. Pro. Amer. Phil. Soc., p. 274. 1873 (in error).

Oblong, rather broad. Front without strioles or depressions; preocular tooth slightly prominent, depressed, supraorbital stria long, distinct. Mandibles slightly longer than head, not striate at base; stout. Pronotum strongly bisinuate at base, with a fine median longitudinal stria extending from the base slightly past the middle; marginal stria entire, rounding the anterior and posterior angles, rather sharply broadened in the anterior half; two short striæ near the anterior margin behind the eyes. Elytra the width of pronotum at base, arcuate on the sides, slightly longer on the suture than the median length of the pronotum; apical angle broad and rounded; bistriate, the first stria short, about one-fourth the length of the elytra, the second very short, without a trace of an apical appendix; subhumeral abbreviated at base and apex. Inflexed portion of elytra rugose. Propygidium impunctate on disk and apex, laterally bordered with a narrow band of punctures which are of two sizes, larger and very sparse on the basal half, finer and slightly more numerous on the apical half. Pygidium finely punctate in an irregular band across the disk, smooth at base and apex, punctures usually separated by twice their own diameter but irregular in distribution. Mentum flat, punctate. Prosternum elevated, truncate at apex. Lower crest of hind tibia not dentate. Length 10 mm.

Distribution. Cahon Pass, California. (Tejon Pass, Cal., Lec.).

This species is distinct from *yucateca*, with which it had been synonomized by Horn (1873), being very much broader, and with the punctation of the propygidium and pygidium sparser and finer. Although *yucateca* occasionally has no apical appendix to the second stria, it is readily separable from *princeps* by the characters given above.

In the Leconte collection in the Museum of Comparative Zoology, there are three specimens, the first of which bears the label *H. princeps* Lec., with the locality Cajan Pass, California. All three specimens are identical. Whether these are the veritable types or not is impossible to say, as the species was described by the elder Leconte, who, so Dr. Schwarz tells me, was accustomed to send his specimens to Count Dejean. Some of his species, however, but which ones we do not know, probably found their way into the collection of his son. I shall consider these specimens as types as they agree with the original description fairly well. The greatest point of divergence between the specimens and the description is in the punctation of the pygidium; the description states that the pygidium is "sat dense" punctured; it is not as densely punctured as the pygidium of *yucateca*, which Marseul says is "densement et assez fortement ponctué." If one had seen *yucateca*, the term dense, even modified, would not be applied to the punctation of the pygidium of *princeps*, as the punctures are in many places separated by from two to four times their own width.

Hololepta (Leionota) yucateca Marseul, Mon., p. 203, t. 5, fig. 1. 1853.
grandis Marseul, Mon., p. 204, t. 5, fig. 2. 1853.
synonomy Marseul, Mon., p. 606. 1860.
Horn, Pro. Am. Phil. Soc., p. 274. 1873.

Broadly oblong. Front with two extremely slight depressions, which may or may not have very lightly impressed striæ at their bottoms; preocular tooth slightly prominent, depressed, supraorbital stria long, distinct. Mandibles longer than the head (♂) or equal in length to the head (♀), stout, usually with a short stria on the upper surface, near the external margin and base. Pronotum bisinuate at base, with a median, longitudinal stria, more or less lightly impressed, extending from the base past the middle; marginal stria entire, rounding the posterior angle, and terminating in a more or less deep fossa close to and behind the anterior angle, rather sharply broadened anterior to the middle (♂) or gradually slightly broadened (♀); two short striæ near the anterior margin behind the eyes. Elytra bistriate, the outer strong, deeply impressed, usually about one-third the length of the elytra, second shorter, usually with an apical appendix of varying length; subhumeral stria abbreviated at base, slightly abbreviated at apex. Inflexed portion of elytra rugose. Propygidium with disk smooth, laterally punctate with a band of moderately coarse punctures which are coarsest near the base; apex very finely punctate. Pygidium densely and coarsely punctate, punctures separated usually by less than their own diameter. Mentum slightly concave, punctate. Prosternum truncate at apex, elevated, punctulate. Ventral segments of abdomen punctate at sides only. Lower crest of fore and hind tibiæ not dentate. Length 8–10 mm.

Distribution. Southern California, New Mexico, Arizona and Texas.

Variants. This species may have the second stria entire, more or less widely interrupted, or with the apical appendix reduced to a very faint line, a series of shallow punctures, or entirely lacking.

The supraorbital stria may be narrowly interrupted at about its middle. The punctation at the sides of the pygidium may coalesce to form a well defined stria of varying length, depending on how many punctures are involved. This stria is always near the base of the pygidium.

The males are usually but not always narrower, and more elongate than the females; their mandibles are longer in proportion to the length of the head, and the thoracic marginal stria is more strongly dilated in the apical half. The length of the stria appendicular is not correlated with sex, and *yucateca* and *grandis* while opposite sexes, are not so because of the length of the appendicular stria, but because of their shape. *Yucateca* is probably the female and *grandis* the male, contrary to what Horn says.

This species is reported from decaying Cereus; in the fruits of Cucurbita, *Echinocactu viridescens*, and in the leaves and stalks of *Opuntia occidentalis* (Fall, 1901).

Hololepta yucateca is very variable and the species as now accepted may be made up of several different elements. Facies, length of mandibles, supraorbital stria, sculpture of front, length of subhumeral stria, length of second stria and its appendix are all variable, but I have been unable as yet to find correlations in any of these characters. The form which has no apical appendix to the second stria closely resembles *princeps* of Leconte in size and facies, but is easily separated from the latter by the punctation of the pygidium.

Hololepta (Leionota) pervalida Blaisdell Zoe III, p. 327. 1892.
Hololepta pervalida Lewis, Ann. Nat. Hist., XIV, p. 139. 1904. (to consider *pervalida* a Mss. name).
pervalida Lewis Catalog., p. 3–5, 1905.
pervalida Schaeffer, Ent. News, XVIII, p. 301, 1907.
pervalida Lewis, Ann. Mag. Nat. Hist., XX, p. 96. 1907.

Narrowly oblong. Front with two mammiform elevations which are delimited by a fine impressed line, deepest at apex, behind the mandibles. In the basal portion of the delimiting line on each side lies a stria which is composed of a series of punctures, and posterior to the stria is a sparsely punctured area which extends across the front, weakest in the center. At the apex of the front in the groove between the elevations there is a small tubercle in the male. Preocular tooth strong, slightly depressed. Supraorbital stria distinct, of varying length, often interrupted. Mandibles stout, carinate, upper margin carinate, broadly curving, as long as the head. Pronotum slightly bisinuate at base, with a strongly impressed median dimidiate longitudinal stria; marginal stria strong, extending around posterior angles, sharply broader anterior to the middle and terminating in a large fossa (♂), gradually widening and terminating in a small fossa (♀), at some distance behind the anterior angles; anterior to the fossa, the surface of the pronotum is rugose and from this rugose area, a fine stria extends along the anterior margin to a point behind the eye; posterior to this stria there is a short broadly impressed stria, which extends beyond the marginal about one-half its own length; margin of pronotum with the marginal stria irregularly punctate, most densely just posterior to the fossa, the punctures more sparse posteriorly and extending along the posterior margin half way to center. Elytra bistriate, the first short, about one-third the length of the elytra, continued along basal margin to the second, with which it sometimes connects, continued to the apex by a series of distant punctures; the second stria entire, and continued along basal margin of elytra almost to the scutellum; subhumeral deep, abbreviated at base under humerus, but sometimes continued almost to the base by a few punctures. Elytra distinctly punctured towards apex. Inflexed portion of elytra rugose. Propygidium coarsely and fairly evenly punctate, most coarsely at lateral margins. Pygidium coarsely but not very densely punctate. Mentum slightly concave, densely, strigosely punctate laterally and at corners, sparsely punctulate at center. Prosternum elevated, constricted in apical fourth, slightly depressed anterior to the constriction, and again elevated at apex, truncate. Ventral segments of abdomen punctate throughout. Lower crest of fore tibiæ dentate. Length 8–9 mm.

Distribution, San Diego, Co., Pasadena, California.

Variants. The second stria of the elytra is not connected with the marginal at base, is punctiform and broadly interrupted.

The males may be told from the females by the shape of the anterior fossæ and the width of the marginal striæ. In the males the fossa has the internal margin sinuate, and the marginal stria broadens suddenly towards the fossæ at about its middle. This broadening of the marginal stria causes the male thorax to look less punctate than the female thorax as part of the band of punctures lies in the broadened portion of the stria. Just before the stria enters the fossa it cuts under the edge of the fossa so that a small tooth projects over the stria, thus causing the inside margin of the fossa to appear sinuate.

Reported to occur in Yucca whipplei (Fall.) and Echinocactus (Blaisdell).

Hololepta (Leionota) vernicis Casey. Ann. N. Y. Acad., VIII, p. 534. 1893.

Lewis, G. Cat., p. 5, 1905 (synon. in error).
Schaeffer, Ent. News, p. 302. 1907.
Bickhardt, Cat., p. 8. 1910 (synon. in error).

Elongate, oblong. Front without strioles; preocular tooth slightly prominent; supraorbital stria very short basal. Mandibles slightly longer than head (♂), or equal in length to head (♀). Pronotum bisinuate at base, with a median, dimidiate, longitudinal stria, lightly impressed; marginal stria entire, deeply impressed, rounding the posterior angles, and ending anteriorly in deep, triangular fossa (♂) or a short hook (♀); punctate sparsely in a narrow band within the marginal stria, the punctures closer and more numerous basally. Elytra bistriate, the first about one-third the length of the elytra, the second about one-half the length of the first, with an appendix extending from the basal fourth almost to the apex; subhumeral stria deeply impressed for most of its length, the basal part fine and reaching almost to the base (♂) or a little shorter (♀). Inflexed portion of elytra rugulose. Propygidium smooth on disk, coarsely punctate laterally, finely punctulate at apex. Pygidium coarsely and densely punctate. Mentum concave (♂), almost flat (♀) evenly punctate. Prosternum elevated, truncate at apex. Ventral segments punctate at sides only. Lower crest of fore and hind tibiæ not dentate. Length 6.5–7 mm.

Distribution, Arizona (type). Huachuca Mts., Arizona (Schaeffer).

Santa Rita Mts., (Schwarz and Barber) Oracle, Arizona.

Variants. One male has a small stria which is attached basally to the appendix of the second stria at an obtuse angle, and so prolongs the appendix that it almost reaches the second stria.

Two specimens have an entire second stria on one side, the other side normal.

The male is slightly broader than the female, has a large deep fossa at the anterior angle of the pronotum, a differently shaped mentum and a longer subhumeral stria.

Reported to occur in dying *Dasyllirion* (Schwarz) and *Agave americana?* (Schaeffer).

Hololepta (Leionota) sirpus sp. nov.

Broadly oblong. Front feebly bistriate, the stria widely separated; preocular tooth moderately prominent; supraorbital stria, basal, short. Pronotum with a lightly impressed median stria extending from base half way to apex; punctate laterally in a narrow band of large, distant punctures; marginal stria entire strong, rounding the posterior angle and extending to a point opposite the second dorsal stria, ending anteriorly in a triangular fossa (♂), or just turning the anterior angle (♀). Elytra bistriate, the first basal slightly more than one-third the length of elytra, second shorter with an apical appendix which reaches past the tip of the first stria and is curved inward at the base; in addition there is short stria outside the first on the humerus; subhumeral stria abbreviated under the humerus at base, and abbreviated at apex. Propygidium bifoveolate at apex, coarsely, moderately densely punctured on the lateral thirds, finely punctate at apex, disk smooth. Pygidium densely and coarsely punctured. Mentum excavated (♂), almost flat (♀). Prosternum elevated, broadly rounded at apex, with an impressed line at the apical fourth. Length: Male, 6 mm.; female, 5.5 mm.

Type ♀. Ramsey Canon, Huachuca Mts., Arizona (W. M. Mann).

Paratype ♂. Mexico.

Hololepta (Leionota) quadridentata. Fal. Ent. Syst. I, p. 74. 1792.
quadridentata (platysma Erisch.) Paykull. Mon., p. 109, t. 9, fig. 4. Larva t. 1, fig. 3 (in error). 1811.
Marseul. Mon., p. 212, t. 5, fig. 10. 1853. p. 608. 1860.
Perris. Insectes du Pin. Maritime. Col. I. (Larva) 1863, p. 123–124.
H. flagellata. Kirby, Trans. Linn. Soc. Lond. XII, p. 395. 1818.
Lewis, Ann. Mag. Nat. Hist., XV, p. 458. 1885.
H. surinamense. Habst. Kaf. IV, p. 51. 1791.

Oval. Front without strioles; preocular tooth moderately prominent, mandibles as long as head. Pronotum markedly bisinuate at base; marginal stria entire extending around the posterior angles to a point opposite the second elytral stria, deeply impressed, except for the portion on the posterior margin of the pronotum which is fine. Elytra bistriate, the first stria short about one-third the length of the elytra, the second entire, slightly arcuate. Subhumeral moderately deep, rugose, extending from apex four-fifths to base. Inflexed portion of elytra not rugose. Mentum slightly concave with an M-shaped excavation which makes the mentum appear carinate. Prosternum elevated, truncate at apex.[1], [2]

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[1] **Hololepta quadridentata** Payk. Mon. p. 109, t. 9, fig. 4, 1811.
Erichson, Klugs. Jahrb. Ins., p. 95. 1834.
Marseul. Mon., p. 212. 1853.

Front with two shallow elongate foveæ, these foveæ divide the head into thirds, and extend longitudinally from the posterior third to the anterior third of the front. (fig. –). Supraorbital stria long, reaching a point almost half-way to the tip of the preocular spine. Front minutely punctate under high magnifications. Pronotum with an extremely faint median dimidiate stria; surface minutely punctulate under high magnifications. Elytra with the first dorsal stria midway between the second and the margin, second stria evenly arcuate. Propygidium appearing smooth on the disk (under high magnifications extremely finely and minutely punctulate), punctate laterally, the punctures coarse, becoming finer towards base, center, and finest but distinct along the apical fourth. Pygidium evenly, moderately coarsely and not very densely punctate, the space enclosed by four punctures being equal in size to one puncture. Visible portion of dorsal segment anterior to the propygidium coarsely and densely punctate. Length 5.75 mm.

Distribution, Peru and Brazil.

[2]Subspecies **quadridentata** Fab.

Front without strioles or foveæ, noticeably punctate, more densely than in the preceding; supraorbital stria extremely short, extending at most less than one-third to tip of preocular spine. Pronotum punctate, more noticeably so than in the preceding. Elytra with the dorsal striæ almost as in the preceding, but the second dorsal has a slight uneven sinuation opposite the apex of the first dorsal. Propygidium less punctate than the preceding, the punctures more widely spaced, and the apex appears smooth. Pygidium unevenly punctate, the lateral punctures twice as large as in the preceding, and more dense, the space enclosed by four punctures being less than half the size of a puncture; punctation finer and more distant at the center. Visible portion of the segment anterior to the propygidium as in the preceding.

Male with the anterior fossa of the thorax well marked.

Length 5.5–5 mm.

Distribution, Mexico.

Subspecies **floridæ** nov.

Head and pronotum as in *quadridentata* but not more punctate than typical form. Elytra with the first dorsal stria closer to the second dorsal than to the margin; second dorsal as in the preceding subspecies. Propygidium with the punctures distributed as in subspecies *quadridentata*, but more densely punctate laterally, and sometimes with a very few occasional punctures on the disk. Pygidium with the punctures spaced as distantly as in the typical subspecies, but diminishing in size towards the center as in *quadridentata*. Visible portion of the segment anterior to the propygidium with slightly larger but fewer punctures than the preceding.

Male with the anterior fossa of the thorax well developed, and deep.

Length 5–4.25 mm. 13 males, 14 females.

Type, allotype and paratypes in my collection.

Distribution, Enterprise, Indian River, Biscayne, Jupiter, Haulover, Florida.

The three preceding have the propygidium more convex and longer in proportion to its width than the following subspecies:

Subspecies **minor** nov.

Front, and pronotum punctulate as in typical subspecies. Supraorbital stria extremely short, basal, usually a single puncture or punctiform. Elytra with the dorsal stria as in the preceding subspecies. Propygidium punctate as in the preceding laterally, but with some of the discal punctures more enlarged than in the preceding forms. Pygidium as in the preceding subspecies.

Male with the anterior fossa of the thorax very shallow and poorly developed. Both sexes with anterior angles of the pronotum depressed.

Length 4.25–3.25 mm. 6 ♂♂, 16 ♀♀.

Type, allotype and paratypes in my collection.

Distribution, Enterprise, Indian River, Florida and North Carolina.

This sub-species has the propygidium more flattened and shorter in proportion to its width than any of the preceding subspecies. There is a gradual decrease in the size of these subspecies; *platysma*, *quadridentata* and *floridæ* are close together in size, and progressively smaller; *minor* is very much smaller. The measurements given above for *floridæ* and *minor* do not seem to show this, but when the average size of a series is taken it is very distinct. The average size of my series of *floridæ* is 4.75 mm., while the average size of *minor* is 4.2 mm.

Subspecies **floridæ** var. **striatifera** nov.

More narrowly oval than typical *floridæ*. Supraorbital stria moderately well defined but short. Marginal stria of thorax entire, with a very shallow semi-circular sinuation just before the middle; under this sinuation and between the marginal stria and the margin lies a short stria. Propygidium and pygidium as in *floridæ*.

Length 4.75 mm. Type in my collection.

Distribution, Florida.

This species is very variable in the number and spacing of the teeth on the lower crests of the hind and intermediate tibiæ; the commoner forms have this crest with two closely approximated teeth on the middle tibiæ, and one tooth on the hind tibiæ, or two moderately widely spaced teeth on the middle tibiæ and two closely approximated teeth on the hind tibiæ; less often we find the spaced teeth of the middle tibiæ combined with a single tooth on the hind tibiæ. One specimen has four small teeth on the lower crest of the middle tibiæ and three on the hind; one specimen has the 4-3 condition on one side and the 2-2 condition on the other. Two specimens from Mexico have one tooth only on the lower crest of both hind and middle tibiæ.

It is reported to occur in decaying palmetto (*Sabal*) by Schwarz.

Hololepta (**Leionota**) **decimstriata** sp. nov.

Oval. Front minutely punctate; supraorbital stria entirely lacking. Mandibles as long as head, punctulate. Pronotum bisinuate at base with a very faint median striæ, which does not reach the base and extends forward past the middle; marginal stria as in *quadridentata*. Elytra longitudinally tristriate, the first stria short, basal, one-third the length of elytra, second entire, slightly arcuate, third short on the apical sixth; at the base of the elytra there is a short, deeply impressed transverse stria, equidistant from the second longitudinal stria and the scutellum. Subhumeral stria deep, rugose, abbreviated at base, reaching the basal fourth and almost reaching the apex; a series of confused punctures between the apical end of the subhumeral and the apical end of the second stria. Inflexed flanks not rugose.

Propygidium moderately convex, with large punctures laterally which grow finer towards the disk and apex; disk smooth. Pygidium with coarse, moderately dense punctures laterally, which become finer and more distant towards the center and apex.

Mentum as in *quadridentata*. Prosternum with the apex more broadly rounded than in *quadridentata*.

Length 5 mm. Type in my collection.

Distribution, Enterprise, Florida (Beutenmüller).

Hololepta (**Leionota**) **bifoveolata** sp. nov.

Oval. Front without strioles; supraorbital stria lacking or very short, punctiform; mandibles as long as the head. Prothorax with the marginal stria deeply impressed, extending around the posterior angles and interrupted slightly anterior to the middle. Just behind the interruption the margin is slightly flattened on the outer surface, producing a very slight emargination when seen from above. Elytra with two dorsal stria, the first strongly impressed, about one-third the length of the elytra, the second less strongly impressed, entire, broadening to a shallow fovea at apex. Subhumeral stria almost as in the preceding but more deeply and narrowly impressed. At a point not quite half-way between the second dorsal and the suture, there is at the base of the elytra a small area, roughened by two or three short longitudinal lines, from which a very finely impressed line extends along the base almost to the scutellum; on each side of the scutellum on the elytra is a deeply impressed, narrow fovea, into which the light line mentioned above sometimes runs. Propygidium and pygidium as in the preceding. Mentum as in quadridentata. Prosternum broad, elevated, truncate, slightly depressed at the tip, the edges of the depression elevated. Hind tibiæ with the lower crest unidentate, middle tibiæ with the lower crest bidentate, the teeth widely separate.

Length 4 mm. Type and paratype in my collection.

Distribution, Enterprise, Florida.

Hololepta (**Leionota**) **interrupta** Marseul. Mon. p. 214, pl. 5, fig. 11. 1853.

Similar in all respects to *Hololepta quadridentata*, sp. *minor*, except that the second dorsal stria is interrupted behind the middle, and the secondary sexual thoracic fossa of the male is rather better developed. Length 4 mm.

Type locality, Cuba. Florida (2).

Two specimens from Florida (♂, ♀), I assign to this species. The male agrees with Marseul's description; the female has the second dorsal twice interrupted, in the basal third and just behind the middle. Marseul states that this species may be told from *quadridentata* by the more lightly punctate pygidium and propygidium, and the "usually" interrupted second stria. He includes this species in his key under the forms which have the second stria entire. The punctation of the pygidium and propygidium of *quadridentata* I have shown to be variable, and I should consider this form to be a variety of *quadridentata* were it not for the fact that when an entire stria is interrupted, the interruption nearly always takes place in the basal third, and the apical portion of the stria becomes shorter progressively. Neither of my specimens shows this condition; the female specimen has an interruption in the basal third, but there is a short stria between this and the more apical interruption. This condition leads me to believe that the apical interruption was the first, and the latter interruption came as it does in a variable stria.

Hololepta (**Leionota**) **vicina** Lec. Ann. Lyc. Nat. Hist., N. Y., V. p. 163. 1851.

Narrowly oblong. Front with two semi-circular strioles which may connect to form a single sinuate stria; preocular tooth moderately prominent; supraorbital stria short. Pronotum with a lateral narrow band of distant punctures, median stria extending past the middle, marginal stria entire, broadening from the anterior third into a shallow fossa behind the anterior angle, posteriorly extending around the posterior angle to a point opposite the second stria of the elytra. Elytra with three stria, the first short, about one-third the length of the elytra, usually continued to the apex of the elytron by a series of punctures, the second entire, third a basal puncture. Propygidium evenly, moderately punctate, the punctures largest laterally, finest on disk and apex. Pygidium densely punctate. On the ventral surface of the head there is extending backward from the base of the mandibles, on the gula a carina much elevated in the anterior half, low and interrupted in the posterior half; the carinæ of both sides form a V, the center of which is evenly excavated (♂), or the posterior half of the carina is obsolete or lacking and the center of the gular plate has a raised boss just behind the mentum (♀). Prosternum narrowly truncate at apex, with a V-shaped slight depression at apex (♂), or not depressed (♀), and very slightly emarginate. Second ventral abdominal segment punctate at sides only; third and fourth distinctly punctate at sides and across middle of disk. Second segment one-third the length of third.

Length 4.25–5 mm.

Distribution, San Diego, Pasadena, Washington, California, Southern California.

Hololepta (Leionota) vicina var. **californica** nov.

Similar in all respects to *vicina* but the third elytral stria is at least half as long as the first stria, though not as deeply impressed. The propygidium is less densely punctate and the punctures are larger and more uniform in size. Length 4.5 mm.

Two specimens labelled S. California (Joutel).

Hololepta (Leionota) vicina subspecies **neglecta**. Blaisdell. III, p. 338, 1892.

Lewis Ann. Mag. Nat. Hist. XIV, p. 139, 1904.
Lewis Cat., p. 3, 1905 (in error).

Narrowly elongate. Front quadristriate; the two usual arcuate striæ are present (as in *vicina*), anterior to these are two short more or less broken striæ, which form with the arcuate stria narrow V's, the apices of which are directed outward (Pl. VI, fig. 2); preocular tooth moderately projecting, depressed; supraorbital stria short, basal. Pronotum with a lightly impressed median stria which extends from the base to the middle; marginal stria entire, extending around the posterior angle to a point opposite the third stria of the elytra, ending apically in a shallow fossa close to and within the anterior angle of the pronotum; a narrow lateral band of punctures inside the marginal stria, most dense at base, very sparse and faint at apex. Elytra tristriate, the first stria short, basal about one-third the length of the elytra, continued to apex by a series of more or less elongate punctures, second stria entire, third punctiform; subhumeral abbreviated at base and apex. Inflexed portion of elytra slightly punctate in a short band immediately inside the marginal ridge, otherwise smooth. Propygidium punctate rather evenly, the punctures large on sides, smaller on disk and at apex. Pygidium densely punctate. Mentum concave, faintly punctate. Gula as in *vicina*. Prosternum as in *vicina*. Mesosternum sparsely punctulate. Second, third and fourth ventral abdominal segments punctate for their entire width. Second segment one-half the length of the third. Length 6 mm. Type.

Distribution, San Diego Co., Cal. (F. E. Blaisdell).

This description is drawn from the type specimen kindly sent me by Mr. Blaisdell. The species is very close to *vicina*, but is much more elongate and has a very different facies. It differs from *vicina* in the sculpture of the ventral segments, in the more convex pygidium and in the shortness of the elytra, which causes the margin of the third dorsal abdominal segment to be visible for its entire width. The type is, I believe, a male.

Hololepta (**Leionota**) **caseyi** n. sp.

Narrower and more elongate than *vicina*. Front bistriate; preocular tooth moderately prominent; supraorbital stria short. Pronotum with a narrow lateral band of punctures; median stria absent or very lightly impressed; marginal stria as in *vicina*. Elytra as in *vicina*. Propygidium coarsely and sparsely punctate, the punctures finer on disk and apex; in a few specimens the disk is almost impunctate. Pygidium densely punctate. Submentum without carinæ and the cup shaped excavation of *vicina* replaced by a Y-shaped groove. Prosternum broadly truncate, its anterior margin narrowly elevate and rugulose (Pl. VI, fig. 1). Second, third and fourth ventral segments punctate at sides, impunctate on disk. Length 4.5 mm.

Holotype and six paratypes. Holotype labelled Arizona, paratypes, Nogales, Arizona.

Genus **Iliotona** gen. nov.

More or less elongate, subdepressed. Head porrect, mandibles subequal. Tibiæ dentate, the anterior quadri posterior and intermediate tridentate. The two lower teeth of the intermediate and posterior tibiæ borne on separate processes, and all three teeth subequally spaced. Prosternum carinate, terminating apically in a sharp point.

KEY TO ILIOTONA.

Pygidium margined. Mandibles without teeth and not dilated at basal fourth. Thorax not grooved near side margin below apical third. . . **cacti** Lec.

Pygidium unmargined. Mandibles suddenly dilated at basal fourth, with a tooth above the dilation. Thorax near side margin slightly below apical third, with a deep transverse groove. . . . . **beyeri** Schaef.

Iliotona cacti Lec. Ann. Lyc. Nat. Hist. N. Y., V. p. 162. 1851.
Mars. Mon., p. 400, t. 10, f. 5, 1857.
Horn. Pro. Phil. Soc., p. 275. 1873.

Oblong, parallel. Front with two shallow impressions which may contain striæ, or be punctured; supraorbital stria long. Pronotum bisinuate at base with a median longitudinal stria extending two-thirds from base towards apex. Lateral margin of pronotum punctate. Marginal stria interrupted at middle by the lateral punctures on the margin itself in a small flattened area, at the interruption of the marginal stria, a single puncture. Elytra bistriate, the first dorsal short, not reaching the middle, second entire, subhumeral moderately deep, abbreviated at base. Inflexed portion of elytra rugose. Pygidium shining on disk, opaque in a band along apex. Coarsely punctate at sides, finely or not at all on disk. Pygidium opaque, finely, rather densely punctate, the apical portion higher, shining and impunctate, thus giving a margined appearance to the pygidium.

Mentum coarsely punctured, triangularly emarginate, with an elevated line extending from the hind angles to the middle or the emargination on each side. Prosternum elevated, narrow, broadened at base, terminating acutely at apex. Length 4.5–7.5 mm.

Variants. This species is very variable in the secondary sexual characters. Mexican specimens have the fossa of the male as a single deep pit, and the disk of the propygidium in both sexes impunctate and are without frontal striæ, the place of which is taken by punctures. These specimens are also much larger than the types.

Texas specimens in my collection have the fossa of the male divided into two parts, the disk of the propygidium is punctate, and the frontal striæ are replaced by punctures.

The Leconte types from San Diego have the fossa single as in the Mexican form, the propygidium is punctate on the disk, and the frontal striæ are well marked, though short and widely separated.

Distribution, Mexico, Texas, and Southern California.

Iliotona beyeri Schæffer. Ent. News, p. 302. 1917.

Elongate. Head sparsely rather coarsely punctate, a few finer punctures intermixed, preocular spine short, indistinct, supraorbital stria distinct. Mandibles elongate, feebly curved at apex, suddenly dilated on the inner side at the basal third, above the dilation, a single obtuse tooth. Pronotum with an impressed median line extending two-thirds from base to apex; marginal stria entire; at the sides slightly below apical third, a deep sinuate transverse groove, above this a shorter straight transverse groove, and below it a very short groove which is connected to the large one by the marginal stria; region near apical and basal angles coarsely punctate; disk smooth. Elytra bistriate, first dorsal short deeply impressed, continued to base by a series of fine punctures, second subentire, ending in confused punctures, subhumeral deep, abbreviated at base and apex. Propygidium shining on disk, subopaque at sides and apex, rather sparsely so on disk. Pygidium subopaque, finely, densely, and evenly punctate. Mentum carinate as in *cacti*. Prosternum elevated carinate, broadened at base, terminating apically in a point. Length 8.5 mm.

Santa Rosa, Lower California.

EXPLANATION OF PLATES, SECTION II.

Plate XXXI.

Fig. 1. Hololepta lucida (♂).
Fig. 2. Hololepta aequalis (♂).
Fig. 3. Hololepta populnea.
Fig. 4. Hololepta (Leionota) decimstriata.
Fig. 5. Hololepta (Leionota) interrupta.
Fig. 6. Hololepta (Leionota) bifoveolata.
Fig. 7. Hololepta (Leionota) quadridentata, ssp. floridae (♂).
Fig. 8. Hololepta (Leionota) quadridentata, ssp. minor (♀).
Fig. 9. Hololepta (Leionota) quadridentata, ssp. floridae (♀).

Plate XXXII.

Fig. 10. Hololepta (Leionota) quadridentata, ssp. minor (♂).
Fig. 11. Hololepta (Leionota) sirpus.
Fig. 12. Hololepta (Leionota) vicina.
Fig. 13. Hololepta (Leionota) pervalida (♀).
Fig. 14. Hololepta (Leionota) neglecta.
Fig. 15. Hololepta (Leionota) caseyi.

Plate XXXIII.

Fig. 16. Hololepta (Leionota) quadridentata, ssp. quadridentata.
Fig. 17. Hololepta (Leionota) yucateca, extreme variant closely resembling princeps.
Fig. 18. Hololepta (Leionota) yucateca.
Fig. 19. Hololepta (Leionota) quadridentata, ssp. platysma.

Plate XXXIV.

Fig. 20. Hololepta (Leionota) pervalida (♂).
Fig. 21. Hololepta (Leionota) vernicis (♂).
Fig. 22. Hololepta (Leionota) vernicis (♀).
Fig. 23. Iliotona beyeri.

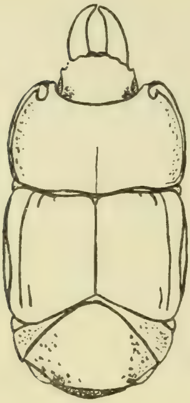
Plate XXXV.

Fig. 24. Iliotona cacti, Texas form (♀).
Fig. 25. Iliotona cacti, Texas form (♂).
Fig. 26. Iliotona cacti, Mexican form (♂).

All figures are of the same magnification, about X 8.

Plate XXXVI.

Fig. 1. Ventral view of head and prosternum of H. (L.) caseyi.
Fig. 2. Ventral view of head and prosternum of H. (L.) vicina.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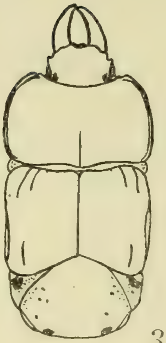
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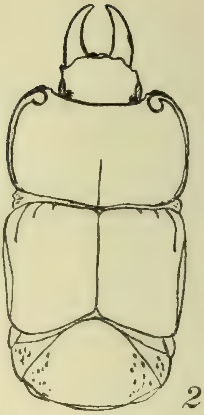
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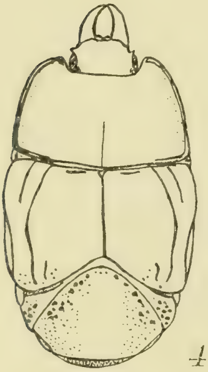
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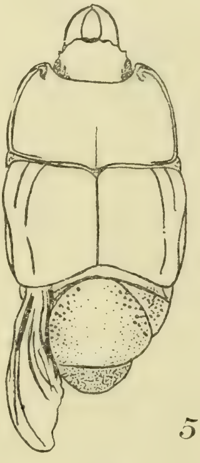
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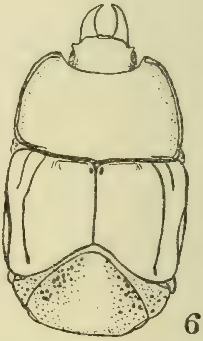
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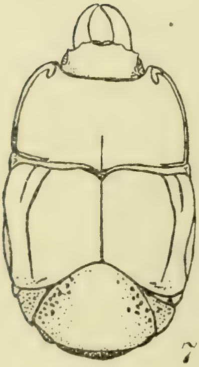
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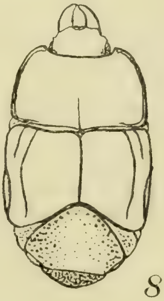
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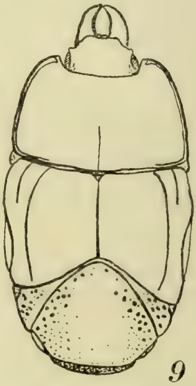
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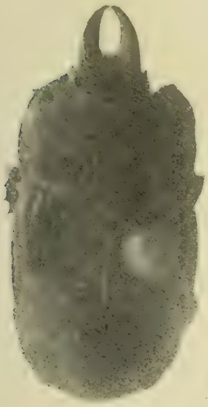
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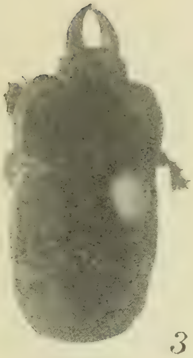
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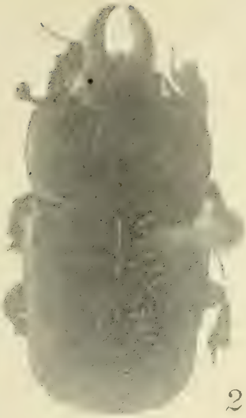
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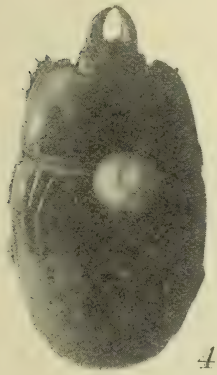
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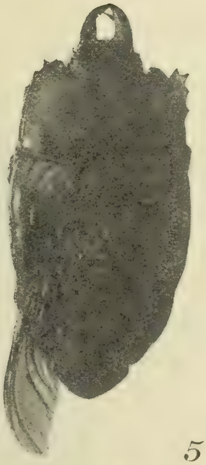
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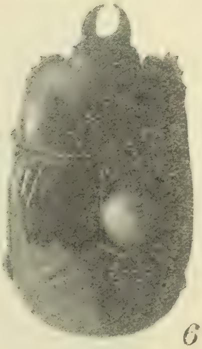
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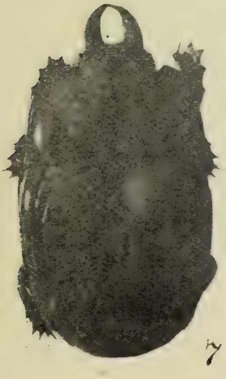
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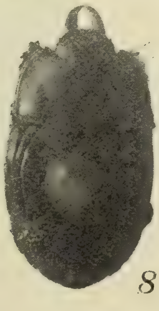
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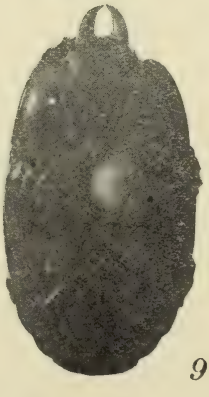
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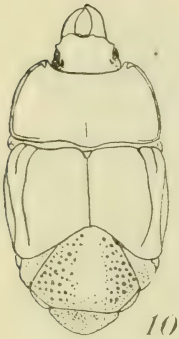
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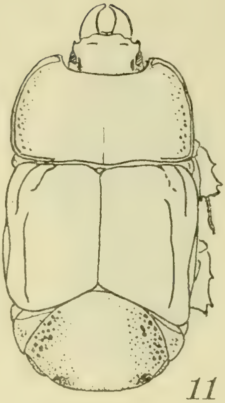
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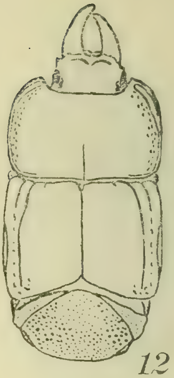
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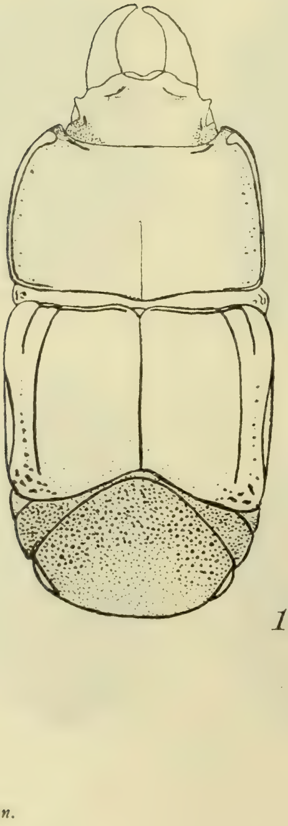
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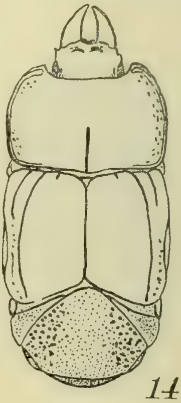
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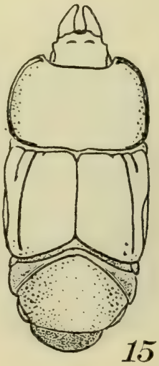
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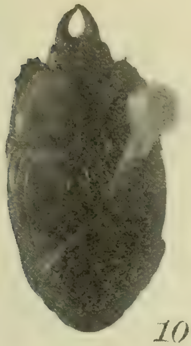

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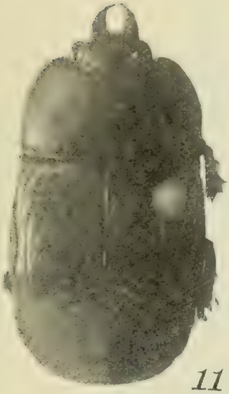

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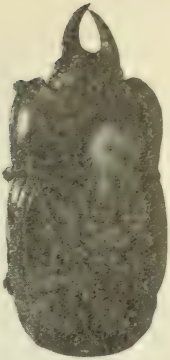

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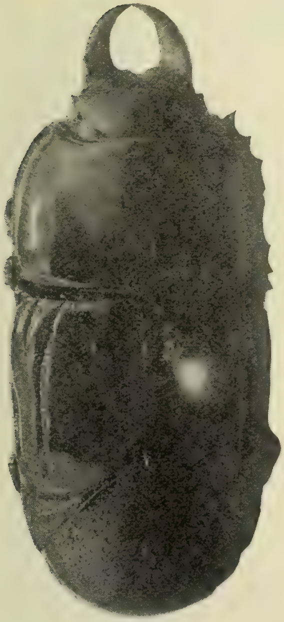

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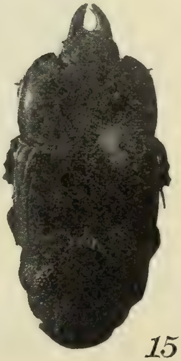

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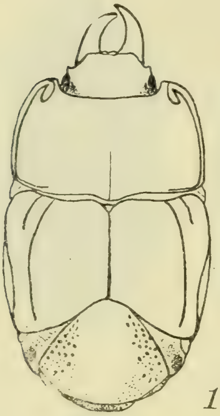

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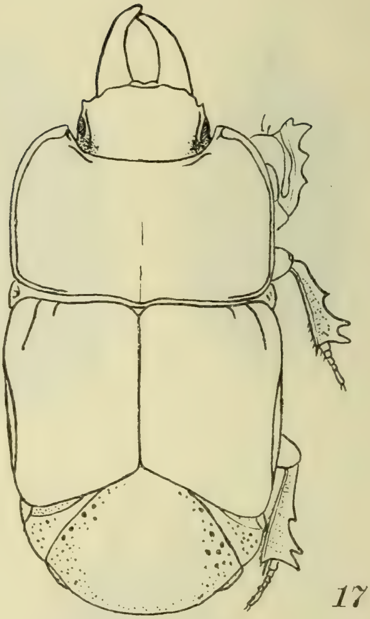

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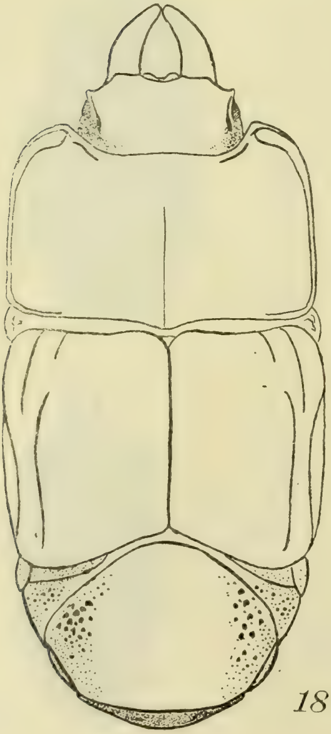

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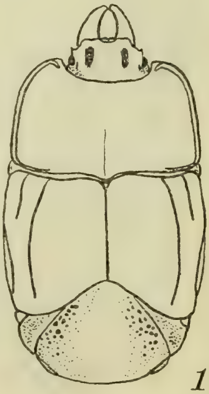

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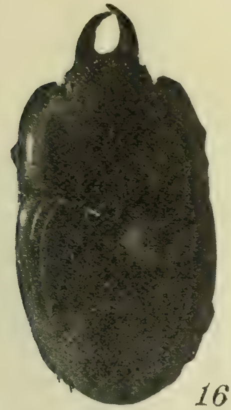

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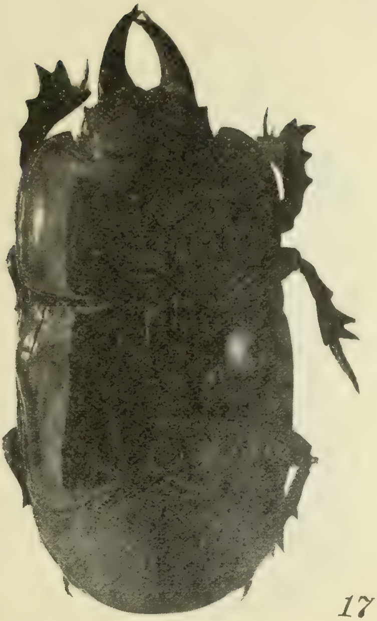

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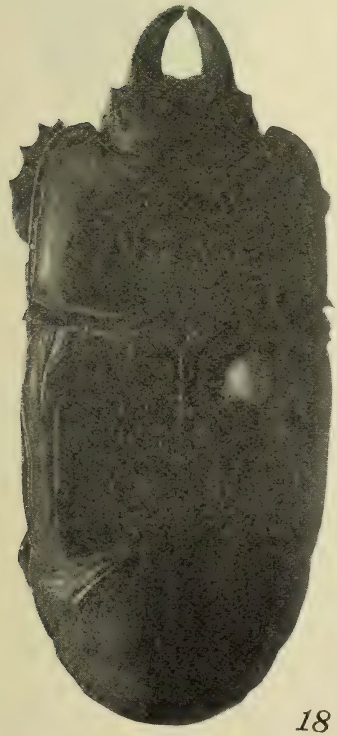

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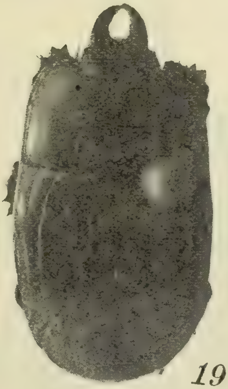

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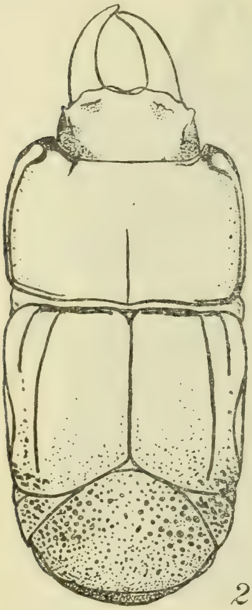
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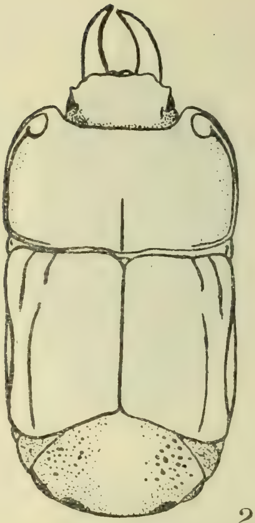
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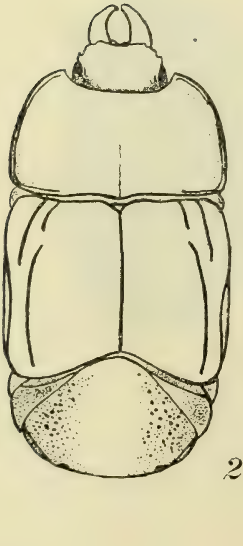
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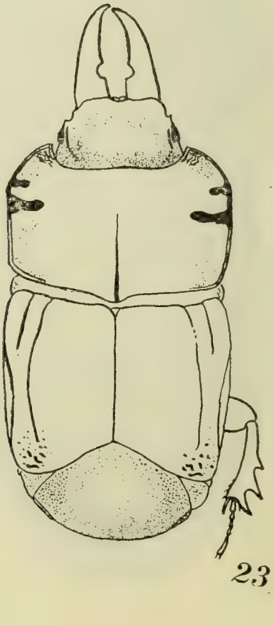
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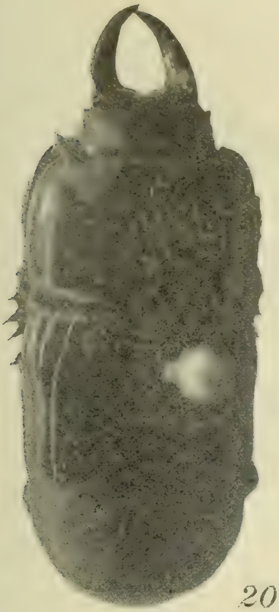
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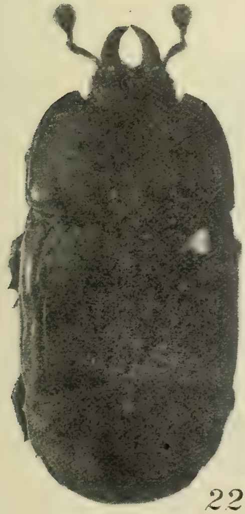
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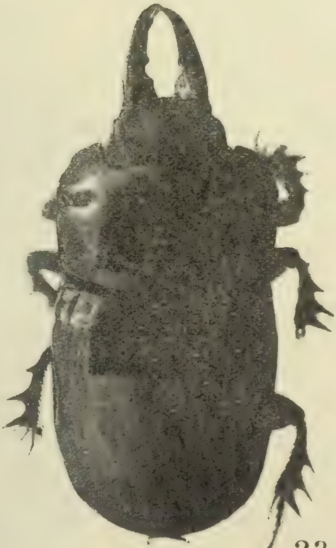
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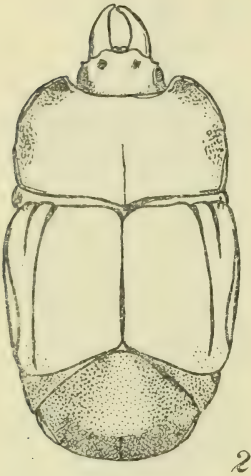

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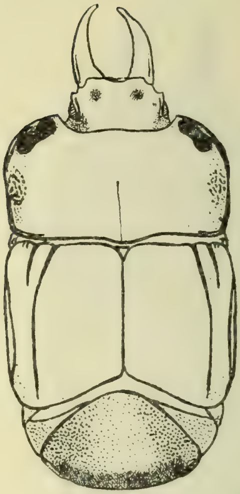

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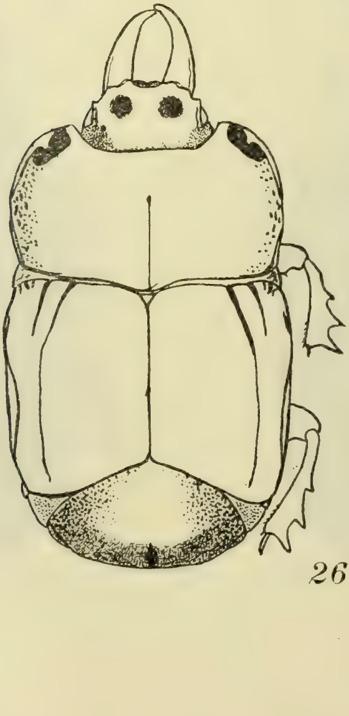

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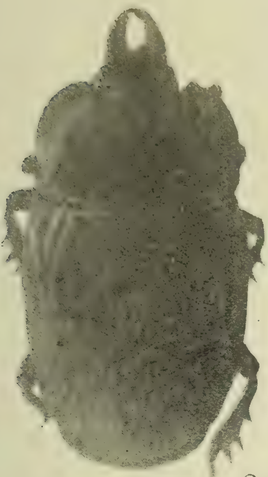

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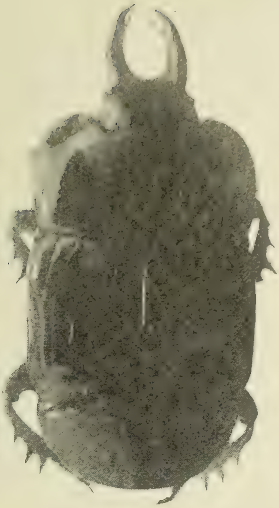

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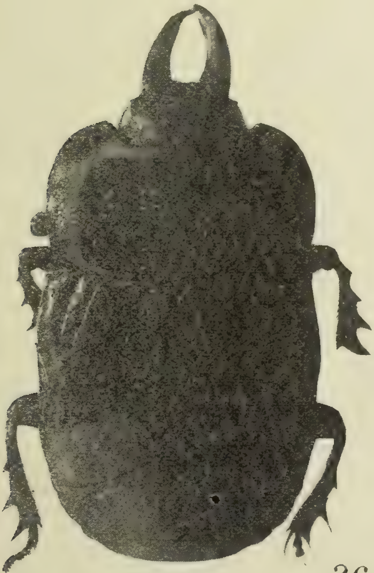

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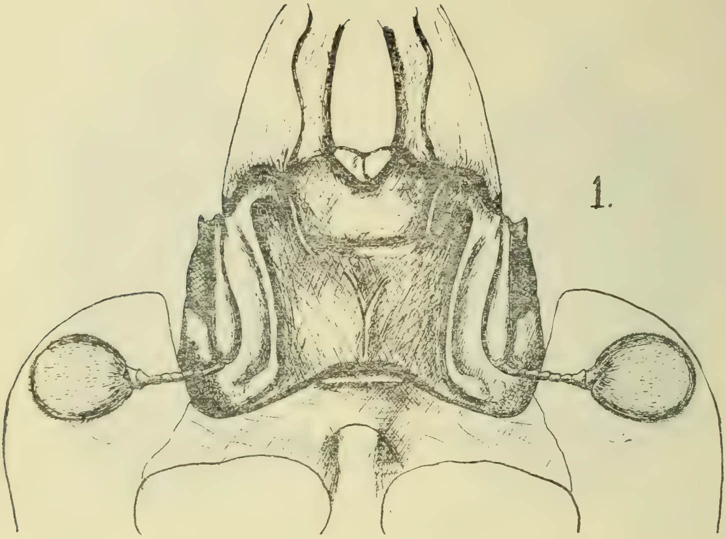

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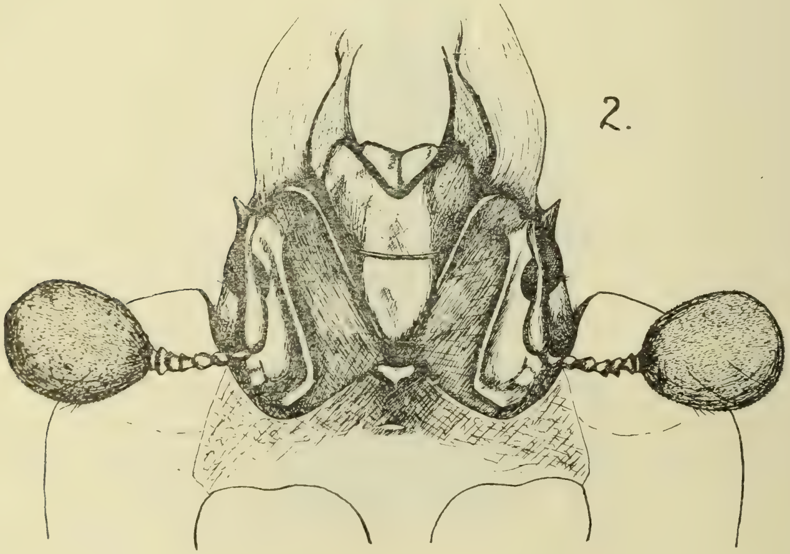

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DEPARTMENT OF HEALTH
OF THE
CITY OF NEW YORK

NO. 60 REPRINT SERIES JULY, 1917

INSECTS AS POSSIBLE CARRIERS OF POLIOMYELITIS INFECTION

BY
C. T. BRUES,
Professor of Economic Entomology
Harvard University

*"Public health is purchasable. Within natural limitations
a community can determine its own death rate."*

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DEPARTMENT OF HEALTH
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CITY OF NEW YORK

NO. 60 REPRINT SERIES JULY, 191

INSECTS AS POSSIBLE CARRIERS OF POLIOMYELITIS INFECTION

BY

C. T. BRUES,
Professor of Economic Entomology
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*"Public health is purchasable. Within natural limitations
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Reprinted from "The Epidemic of Poliomyelitis in New York in 1916," Monograph Series No. 16, Department of Health, City of New York.

INSECTS AS POSSIBLE CARRIERS OF POLIOMYELITIS INFECTION.

AN ENTOMOLOGICAL STUDY OF THE 1916 EPIDEMIC IN NEW YORK CITY.

By Charles T. Brues, Professor of Economic Entomology, Harvard University.

Early in August work was undertaken under the direction of the Health Department along entomological lines, with the hope that either positive or negative evidence might be obtained bearing on the frequently repeated suggestion that insects of one kind or another play a part in the spread of this disease. This work is so valuable and suggestive that it is given practically as reported.

* * * * * * * * *

On account of several peculiar facts connected with previous epidemics of poliomyelitis, it has appeared possible that the disease may not be spread directly from one person to another like most acute infectious diseases, but that it may be dependent for its spread upon some intermediate agent, or perhaps upon some other host or living reservoir, or possibly upon a combination of the two. The most patent facts which have suggested such hypotheses are those connected with the epidemiology of the disease. Others made known by laboratory experimentation would seem to show that the disease is passed directly from one affected human individual to another through immediate contact, involving the transfer of the virus from the first person to the nasal passage of the second. That it may be spread through the agency of dust or by various other means has also been suggested.

The facts which lend color to the belief that insects are concerned are numerous, and some seem to be of considerable importance. Epidemics almost invariably begin during the early part of the summer, in late May or June, reach a climax during early August, then rapidly decline and practically disappear in October. This seasonal incidence corresponds with that of certain diseases known to be insect-borne, and does not occur with other diseases, concerning which we know that insects play no part in their transmission. Certain enteric diseases show a marked summer increase, but they also are partly spread by flies. They never show the almost complete winter disappearance exhibited by poliomyelitis in this country. The disease has always been regarded as more abundant under rural conditions, and the present outbreak, although it has occurred in a large city, has not altered this belief, since the Boroughs of Richmond and Queens, the only boroughs which are to any extent rural, have suffered more severely than their heavily populated neighbors. Insects of practically all kinds, except those which depend entirely upon human beings for their existence, are more abundant in proportion to the human population in the country or in

Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, in cooperation with the Department of Health, New York City. Bussey Institution No. 135.

small towns and villages. Cases of this disease do not usually appear in such a way that they can be positively traced to contact, and many facts connected with their spatial distribution, as detailed in the present report, seem to be more easily explicable on the basis of transfer by insects or other animals, or by both. As a result of epidemiological studies undertaken some years ago in Massachusetts (by Brues), it was suggested that the stable-fly (*Stomoxys calcitrans*) might be the insect agent by means of which poliomyelitis is transmitted. The following year the disease was apparently passed from monkey to monkey by the bites of this fly in two laboratories.*

But these experiments have failed of further confirmation, and cannot now be regarded as free from possible error. As shown later, there is at least one other possible explanation of the epidemiological evidence secured both before and during the present epidemic in New York City.

This summer's outbreak has offered so many opportunities for study that have not previously been available that it is of peculiar interest and value. It has involved a population living under such entirely different conditions from those existing in places where previous epidemiological investigations have been made, that much evidence of an entirely new nature has come to light.

On this account, it has been thought advisable to give a brief summary of a number of facts and observations of more or less general nature, before dealing with the matter from a purely entomological standpoint.

GENERAL DISTRIBUTION OF CASES OF POLIOMYELITIS IN GREATER NEW YORK IN RELATION TO A POSSIBLE INSECT CARRIER—DISTRIBUTION IN THE BOROUGH OF MANHATTAN.

By the middle of September the incidence of poliomyelitis reached a very little over one per thousand of population (1.01) in the Borough of Manhattan, thus falling considerably short of that in Brooklyn and Staten Island, which will be considered separately. A glance at a spot map upon which the Manhattan cases have been marked shows a distribution and abundance which would seem at first glance to correspond quite closely with the general distribution of the human population of the island. On the east side below 34th Street and above Brooklyn Bridge to the east of the Bowery and Third Avenue, there have been a great many cases, and the map is thickly spotted in conformity with the great density of population in this portion of the City. To the west of this, extending from West Broadway between Canal and 4th Streets northwestward between Bedford at West 4th Street to Grosvenor Street and North River, is another area with a large number of cases. This also corresponds roughly to a heavily populated area, except that this group of cases extends nearer to North

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* By Rosenau and Brues at the Harvard Medical School in Boston, and by Anderson and Frost at the Federal Hygienic Laboratory in Washington.

River and further south along West Broadway than might be expected on the basis of population. On the middle west side, between West 23d Street and West 32d Street, are a number of well-defined, small foci which do not correspond to a densely populated area. Again, west of Broadway, between 45th and 70th Streets, a great many cases have occurred over a large area which does not support a very dense population. On the upper east side the abundance of the disease corresponds well with the comparative density of the population, as there is a large number of cases above 95th Street, the incidence dropping off above 119th Street and 124th Street, in close accord with the density of the population. On the upper west side, between Manhattan Street and West 135th Street, is a large, well-defined focus which does not in any way correspond to a thickly populated area.

In general, over the whole Borough of Manhattan the cases have been grouped in a band of varying width, nearly always contiguous to the water fronts of the East and North Rivers, with a narrow portion of the island almost entirely unaffected. This is particularly true south of Central Park, the difference being less marked north of the park. It is thus seen that with some striking exceptions there have been a far greater number of cases per acre in thickly populated areas, with an evident tendency to heavier infection irrespective of density of population along the sides of the island near the water fronts of both the East and North Rivers.

When certain areas are examined more in detail, it is seen that they throw further light on the distribution of cases in relation to population and to other possible factors.

Lower East Side—

The portion of Manhattan east of Catharine Street, the Bowery and Third Avenue south of 14th Street includes a population of over half a million persons. In practically no considerable part of this area does the population fall below 300 persons per acre, and in over half of the acre it ranges from 500 to over 800 persons per acre. Most of the inhabitants are housed in five or six story tenement houses, which line the streets in almost unbroken series. There are large numbers of food-shops and other small stores of various kinds on the street floors of these tenements, and the entire child-population necessarily spends its time upon the streets, the entries to buildings, and the open spaces which serve as back yards to the tenements. Under such conditions it is evident that the opportunities for the spread of contagious diseases must be great, since the number of healthy children that may come in contact with one harboring a contagious disease is greatly enhanced by the congestion of the limited areas in which the children play.*

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* As the populations of the small areas here referred to have been taken from the census of 1910, figures from the same census have been used for comparison with the city as a whole. The different rates of growth in various parts of the city cannot have been sufficiently different to change the incidence rates appreciably.

As has been said, the smaller sections of this east side area represent several distinctly different densities of population, which may be grouped as follows:

Area.	Population.	Cases of Poliomyelitis.	Rate Per 1,000.
Area with Over 800 Persons Per Acre.			
51 acres	44,500	29	0.6
416 acres	37,700	24	0.6
52 acres	42,000	30	0.7
Total	124,200	83	0.66 rate
		Per acre	0.55
Area with from 600-799 Persons Per Acre.			
54 acres	37,700	32	0.8
47 acres	30,400	16	0.5
40 acres	25,100	19	0.7
36 acres	23,100	18	0.7
Total	116,300	85	0.73 rate
		Per acre	0.48
Area with from 500-599 Persons Per Acre.			
56 acres	28,600	18	0.6
63 acres	34,900	66	1.9
42 acres	22,800	25	1.1
43 acres	25,700	43	1.7
43 acres	23,500	31	1.3
Total	135,500	183	1.35 rate
		Per acre	0.74
Area with from 400-499 Persons Per Acre.			
58 acres	24,400	43	1.7
52 acres	25,700	22	0.8
43 acres	18,800	21	1.1
52 acres	25,500	15	0.6
39 acres	16,300	16	1.0
55 acres	27,100	42	1.5
Total	137,800	159	1.15 rate
		Per acre	0.53
Area with from 100-135 Persons Per Acre.			
47 acres	5,600	6	1.0 rate
		Per acre	0.13

From this table it will be seen the area of densest population has had a very decidedly lower incidence than any of the more thinly populated sections in this part of the City. As a matter of fact, the highest incidence has been in the group of 500-599 persons per acre, although this group has not had a noticeably greater incidence except in one small part than the group of 400-499 persons per acre. Thus the only direct relation of density of population to incidence of poliomyelitis has been an inverse one in this district, if the incidence be related to density at all, and this agrees with the general tendency noted elsewhere for sparsely settled regions to be more severely affected.

If in this same district, we compare the incidence with the area, *i. e.*, the incidence per acre, we find that it is more nearly uniform than it is in relation to human population (with the exception of one small area with only 115 persons to the acre), since this incidence varies only from .48 to .74 per acre. This is suggestive of the possibility that some other population than the human one may take part in determining the incidence of the disease in children. With this in mind, if we compare the incidence in the densely populated sections (see Map 1) contiguous to the water front with the remaining sections, we find that it is as follows:

	Cases of Poliomyelitis.	Population.	Incidence Per 1,000.	Acres.	Incidence Per Acre.
Contiguous to water front	213	145,400	1.46	313	.68
Removed from water front	318	388,300	0.81	615	.51

This indicates that the incidence has been much higher along the water front, both in relation to population and in relation to the actual area of the sections, corroborating the general impression that there has been a well-marked tendency for the cases to group themselves along the water front throughout the City. In this particular instance none of the sections are far removed from the docks which line the river, although the strip selected for comparison lies directly adjacent to the water while the others do not. This grouping is also suggestive of a factor aside from human population and social conditions. It is at least not contrary, but is what might be expected if the rat should bear some relation to poliomyelitis, and might possibly be explained on such an hypothesis.

On the other hand, for no reason which seems apparent, the three sections (see Map 1) which mark the northern limit of the thickly populated district between 9th and 14th Streets, all have a very high incidence:

Cases of Poliomyelitis.	Population.	Incidence Per 1,000	Acres.	Incidence Per Acre.
85	68,000	1.25	129	.66

It does not equal that of the sections along the water front, but is, nevertheless, far in excess of the other sections removed from the water front. Whether this strip supports a larger rat population than its neighbors on the south would be difficult to say. In so far as insects of any kind are concerned, it seems impossible to understand the peculiar distribution of poliomyelitis in this district on the basis of their comparative abundance. It is true that the stable fly is especially abundant along the water front on account of the large amount of trucking which goes on there, but it is not noticeable that the disease has spread along the streets which are most generally used for teams. The disease should follow these streets if the stable fly were concerned, as this insect migrates most abundantly along thoroughfares through which many horses pass regularly. That it has not followed these streets would therefore seem to be significant, especially in view of its greater prevalence along the northern strip of this district where there is no more traffic than in the other portions further south. One fact which seems perfectly clear is, that under urban conditions of this type where large numbers of persons are crowded in congested dwellings, there is no tendency toward a rise in the incidence of poliomyelitis. This is abundantly shown by the details which have been cited in the preceding pages, and offers poor support to the view that these cases have been contracted as a result of contact with children suffering from the disease, or as a result of contact with healthy carriers of the poliomyelitis virus.

Lower West Side—

Considerable interest attaches to a small group of cases on and about Greenwich Street just north of Battery Park. Only about a dozen of cases have appeared here, the first during the last week in July, and the others in irregular sequence during August into September. This focus has remained entirely isolated from any others, although it is not separated from them by a space devoid of dwelling houses. Its direct connection with a large focus near the West 132d Street docks is, however, evident since there are boats plying daily between these uptown docks and those directly adjacent to the Greenwich Street focus. These boats might easily serve for a transferance of rats, but their passengers come from widely separated parts of the City, and not particularly from affected regions about Greenwich Street or West 132d Street.

Middle West Side—

Although the area to the south of West 33d Street and West of Sixth Avenue has not suffered severely, it shows a very interesting distribution of cases into several small, well-defined, and more or less isolated foci, each of which includes only a few cases restricted to a single block or to two adjacent ones. The grouping and form of these very small foci is of such particular interest that it is dealt with on another page.

Further uptown there is a noticeable concentration of cases in the district adjoining the stock yards in the vicinity of West 68th Street. This group is quite discrete, but the cases are not so closely associated as in a number of other districts. As the group is in proximity to the stock yards, there is here an especially great opportunity for both rats and the various bloodsucking flies, such as the stable fly and the members of the genus Tabanus, which are associated with the larger domesticated animals.

Upper West Side—

An extremely interesting group of cases has developed near North River between West 126th Street and West 142d Street, most concentrated (see Map 2) between West 130th Street and West 132d Street. In this area by the middle of September 42 cases had appeared and later several more had been reported. The density of the population is very much less than in the district on the lower East Side, which has been referred to on a previous page. It ranges from 83-140 persons per acre, with an incidence of poliomyelitis of from 0.8 to 3.6 per thousand of population, as shown in the following table:

Area.	Population.	Density Per. Acre	Number of Cases.	Rate Per 1,000.	Rate Per Acre.
47 acres	3,900	83	8	2.0	.17
50 acres	6,800	137	25	3.6	.50
47 acres	3,500	176	3	0.8	.06
47 acres	6,600	140	6	0.9	.12
Total	20,800	......	42	2.0	.22

It thus appears that the incidence in this area of comparatively sparse population has greatly exceeded that on the lower East Side, being as a matter of fact almost double, showing again very evidently that maximum incidence under these quite urban conditions is not a function of the population density. The same fact is, of course, evident by the very irregular distribution of cases in practically every locality affected, but on account of the great number of factors which may be involved, it is difficult to draw conclusions from this. It may be said, however, that it does not accord well with what might be expected if some actively flying insect were concerned in the dissemination of poliomyelitis. It does resemble at first blush foci which have developed in the City as a result of carrier typhoid infection, but many of these poliomyelitis foci cannot be associated with any probable carrier, and besides, the distribution of the whole epidemic corresponds in no way to that of typhoid. This matter is dealt with on another page.

There have been other smaller, and a number of larger, sparse groups of cases in Manhattan, but most of them do not show a sufficient size or concentration to make it evident that they represent really definite differences in incidence. Irregular population distribution and many minor factors might so easily account for them that they can hardly form the basis for generalizations.

Distribution in the Borough of The Bronx—

The number of cases in The Bronx has been comparatively few and the incidence correspondingly much lower than that in other boroughs. There have been no foci of any considerable size or density, although earlier in the course of the epidemic it seemed probable that several were developing. These proved to be evanescent, however, and later cases have produced a quite even distribution over the area north of the Harlem River and between the line of the New York Central on the west and the New York, New Haven and Hartford on the east as far north as Bronx Park and Fordham University. Along its western boundary this area has extended a short distance west of the railroad, but the western part of The Bronx has been practically free from infection—in fact remained almost entirely so until very late in the course of the epidemic. This western section is very much more sparsely settled than the eastern one which suffered from poliomyelitis, and is quite generally separated from it by much nearly vacant land. Nevertheless, it has continual intercourse with the City. We could find no lack of insects in this district—in fact conditions are favorable for the production of our common bloodsucking flies. The land is considerably elevated and thus well separated from the railroad that skirts the Harlem River Canal. It would, therefore, appear unlikely for rats to reach it from the railroad on account of its sharp elevation on this side. Also, the region is devoted almost exclusively to the homes of the well-to-do, who remove their children from the City for the entire summer.

Distribution in the Borough of Brooklyn—

Since the present epidemic first gained serious proportions in Brooklyn, especial interest naturally centres upon its behavior in this borough. The incidence has been considerably over twice that for Manhattan, and the disease has appeared abundantly in districts of several types. As it has also showed a more or less constant movement or shifting from the first centre, the course of the disease in Brooklyn offers much valuable information.

In the immediate vicinity of its origin in Brooklyn, the epidemic did not gain the intensity which it showed some time later in adjoining districts into which it had spread in the meantime. There has been, however, a great number of cases in the district into which the northern end of the Gowanus Canal extends, an area which is roughly coincident with the first indications of an epidemic. Here the greatest number of cases have appeared in the district west of Third Avenue, north of Third Street and south of Wyckoff Street. They have extended to the East River in decreased numbers over a narrow space, and then in greatly increased abundance along the region adjoining the water front from Joralemon Street to Hamilton Avenue. This portion of Brooklyn is rather thickly settled, but the dwellings are to a great extent old wooden houses that do not contain a great number of families. On the whole, it is eminently suited to support a large population of rats and a considerable one of house flies and stable flies, the former on account of its proximity to the water front, its old houses, and the latter also by reason of its numerous stables. On the whole, the sanitary conditions under which its inhabitants live are bad, partly from necessity due to the surroundings and partly from lack of desire for cleanliness.

To the south of this part of the borough, and separated by a narrow strip, is another area in which a great number of cases have occurred. This follows quite closely along the water front and extends as far as 60th Street, with only one or two insignificant breaks. The northern part of this area is composed of blocks which contain tenements that house a large number of families, and consequently this part has had more cases in proportion to its area than the part further south, which includes a great number of smaller houses. These smaller houses are in many cases old wooden buildings, but many are of far better stone and brick construction, although nearly all were built many years ago. A few newer apartment buildings of small or moderate size are scattered through this southern part of the district. Although of far better appearance in nearly every respect, much poliomyelitis has appeared here. It has undoubtedly shown a preference for the older wooden houses but has nevertheless occurred quite commonly in the neatest of the small brownstone and brick houses. On the whole, the probability of a considerable rat population here would seem less likely than in almost any other part of the City in which poliomyelitis has appeared abundantly.

In proportion to its resident population, Coney Island, which forms the southern end of Brooklyn, has suffered quite heavily. Here there have been two more or less clearly defined foci with a few more scattered cases. The greater part of these has been in old houses under bad sanitary conditions, and neither rodents, flies or insects could be excluded.

The most extensive group of cases in Brooklyn was in an irregular area. The upper arm extends from East River between the Williamsburg Bridge and Greenpoint Park eastward to somewhat beyond Myrtle Avenue. The lower arm drops considerably to the south of Myrtle Avenue as it approaches the west and stops short just before reaching the Navy Yard. The whole group is more or less distinctly separated from the foci further south, but is connected by a narrow group that extends along the southern boundary of the Navy Yard, and then suddenly enlarges to occupy a considerable area about the approaches to the Brooklyn and Manhattan Bridges. Below this, however, there is a distinct break of fully a quarter of a mile before the limits of the first Brooklyn area mentioned is reached. The space between the arms of the above-mentioned include the area bounded by Division Avenue, Broadway, Wallabout Street and the Navy Yard. Within this space only a comparatively few scattered cases have occurred. This section includes much of the older, more thickly settled portions of Brooklyn, and supports a rather uniformly dense population. The incidence of poliomyelitis has been very high, much higher than in the densely populated sections of the lower East Side in Manhattan, although the inhabitants do not live under such conditions of congestion as their neighbors across the river.

The last distinct group in Brooklyn to be mentioned is one which embraces the Hebrew section commonly known as Brownsville. Here the incidence has not been so high as might have been expected from the conditions which prevail. The population is sparser than in the last-mentioned section, but not sufficiently so to account for the great scattering of the cases. This group is quite sharply limited to the north by Atlantic Avenue, for above this, in the better section, a smaller number of cases have occurred.*

From this it can be seen that the distribution of the cases in Brooklyn has been apparently much more erratic than in Manhattan. Practically all of the water front which supports large shipping activities has had a dense fringe of cases in the residential blocks that extend inland. In this respect it has shown a more or less close agreement with Manhattan. About Gowanus Canal the district affected has extended inward further, possibly through some influence exerted by the canal. The large area northeast of the Navy Yard adjoins the water only for a very small part of its extent, and extends inland over an area of closely built-up blocks of mainly old houses. In Brownsville far removed from the water front the incidence has been lower than might otherwise has been expected, from comparison with other parts of Brooklyn. On account of its strict adherence to the environmental conditions mentioned, it seems evident that the method of propagation, if it be other than chance contact of individuals, must depend upon something correlated with such conditions. The proximity of so many affected areas to the water front, the exceptions being in two closely populated districts of which the one farther removed from the water front suffered less than was expected from living conditions, both point to some population other than the human one. No insect which I have observed abundantly seems to fulfill these conditions, although the epidemiological conditions, including the spread in the Brooklyn areas, would seem to be explicable with little difficulty by rat prevalence and migration.

Distribution in the Borough of Richmond—

Staten Island, the least urban of the Boroughs of Greater New York, has suffered very severely from poliomyelitis during the present outbreak. With a population of less than 100,000 persons and over 290 cases, the incidence has been approximately 3 per thousand. This is particularly interesting since it gives an opportunity to compare the same epidemic under conditions prevailing in the lower East Side, probably the most congested district in the world, with Staten Island, a small city with attendant villages and countryside. The triply greater incidence in Staten Island bears out our previous experience that poliomyelitis is a rural disease, more prevalent in thinly settled districts than in cities. This fact of course suggests, as it has in other parts of our own country and abroad, that the dissemination of the infective virus is dependent upon some insect or other animal population which is uniformly more abundant in proportion to the human population under rural conditions than it is in cities. An examination of the island from an entomological standpoint has unfortunately failed to disclose much further information of apparent value. The cases are grouped into what may be conveniently classed as four types. Many are in the older and more thickly settled parts of the island. They have been as a rule in the poorer sections and streets and along the water front, the latter in this case contiguous to the most thickly settled parts. Others have been in suburban residence districts of well-built, well-kept and separated houses. Others have been scattered throughout the thinly settled parts of the island, usually along or not far removed from the main thoroughfares which traverse it. A few have been at summer camps where large numbers of city people are crowded together in small one or two room tent houses or "bungalows." These camp houses have been comparatively free from poliomyelitis, considering their quite considerable population. They are built directly upon the sandy beaches, very generally raised from the ground by wooden blocks or short pillars, and this, in connection with the fact that these camps are vacant during the winter, must reduce the rat population very greatly. If this condition be compared with that in the section of Coney Island which has suffered, it is seen that prevalence of rats is evidently in these two cases parallel with that of poliomyelitis. In the two places flies of the common kinds do not appear to be noticeably different in abundance.

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* Brownsville was infected in the previous epidemic of 1907.

The general distribution in Staten Island is so similar to that already observed during many epidemics in small cities with their surrounding villages and scattering houses, that I have been unable to find any striking peculiarities. Some cases have been almost entirely isolated, but in many instances there have been groups of two or three nearly simultaneous cases. Some of these have been in single houses or families, 21 secondary and tertiary cases in all, or over 7 per cent. of the total 290 cases. This percentage of secondary cases in Staten Island is at least double that in Greater New York as a whole and is difficult to understand on the basis of infection from person to person, since there cannot be twice the opportunity for such contact in Staten Island. This excess should be anticipated, however, in the case of transmission by insects infected from a non-human host, if their population is greater in proportion to the human population. It would result in a greater number of infective agents at work among a smaller number of persons, so grouped that the houses or family stands out as a definite spatial group liable to multiple infection. Such house or family isolation of this type does not occur in the other boroughs to any extent, and we do not find so many double or triple cases in them.

The other groups of two or three cases, mentioned above as near together but not in the same house, have appeared in a number of more or less isolated spots on the island. They would appear to be homologous to the similar pairs or small groups that are continually cropping out in the thickly settled boroughs, due apparently to the appearance of some infective agent. The distance traveled by the agent cannot be traced under the complicated conditions prevailing in the other boroughs, but in Richmond, as in other sparsely settled districts, the distance possible in a short space of time is evidently at least several miles. This is, of course, easily explained either by the possible advent of a human carrier, or by the appearance of some insect or rodent, since the same method of spread has been observed with yellow fever and bubonic plague when they have spread by introduction into places where they are not endemic.*

As the Staten Island outbreak is being very carefully studied and tabulated by others, their findings may show that some of my own brief observations have been misleading. At any rate the behavior of the disease on Staten Island has been surprisingly like its previous behavior in other small cities, and the divergencies which appear between this borough and the others of Greater New York consequently become of enhanced value.

Distribution in the Borough of Queens—

The entomologist has not given much attention to this borough, partly as it did not seem to exhibit conditions strikingly different from those observed in other parts of the City and partly because of the impossibility of covering such a large area with any degree of completeness in the limited time available. One well-defined focus of about twenty cases in Long Island City was visited. This locality is very much like those referred to in the Borough of Brooklyn, in the region of the Gowanus Canal. It is directly on the water front, adjacent to the yards of the Long Island Railroad, and near Newtown Creek. The area occupied is very closely isolated from any other focus, and the cases appeared over a considerable period during July and early August. Over half (11 cases), however, were reported during a single week following the middle of July. The course of cases in this focus has followed the usual rule observed in others; an isolated case, one or two more coincident or a few days later, after a couple of weeks a considerable proportion of the entire number, then a gradually dwindling scattering of cases.

One other locality in the Borough of Queens which suffered rather heavily was the extensive summer colony which extends along Rockaway Beach. Many cases appeared here in three or four poorly defined groups. Here the conditions are similar to those of Coney Island except that the houses are of better construction and in somewhat better condition. They are, however, old and not of the small type with open-air space below mentioned in connection with Staten Island.

Distribution Summarized—

In reviewing the material presented in the present section of this report the following facts seem worthy of repetition:

In general the cases of poliomyelitis have grouped themselves more or less in proportion to varying density of population in different portions of the various boroughs. There has nevertheless been a distinct tendency toward a higher incidence in sections directly adjoining Brooklyn.

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* A small epidemic of yellow fever on the Island of Barbadoes described by Boyce, and several small outbreaks of plague in Sydney, N. S. W., are extremely interesting in comparison with the present poliomyelitis epidemic in Staten Island.

Great density of population does not tend toward a higher incidence of the disease. This is shown particularly from a comparison of the East Side tenement section with other parts of Manhattan.

Numerous areas have been practically free from infection, while others of apparently similar character and human population have developed extensive foci of poliomyelitis.

Staten Island has suffered more severely than any other borough except Queens, showing the usual tendency of poliomyelitis to affect rural districts more heavily than cities. The high incidence in Queens was reached during the last weeks of the epidemic, as the disease spread to the more thinly populated sections.

Many facts of distribution and general prevalence suggest that the disease is at least to some extent dependent upon some population other than the human one for its spread. Insects migrating by themselves, or on the body of some animal host like a rat, might easily account for the facts dealt with in this section of the report.

Distribution of Cases in Relation to the Immediate Neighborhood.

In referring to the general proportions of the epidemic in the several boroughs, and in the smaller areas where definite foci have developed, it has been impossible to deal with a great many facts which have a bearing on the possible relation of insects to the spread of poliomyelitis. Some of these may be conveniently discussed separately.

The Grouping of Cases in City Blocks—

The completed block in a city forms a more or less definite entity, which differs in many respects from a mere aggregation of dwellings. It is completely walled in on its four external sides and usually encloses a large common space which is divided into yards apportioned to the dwellings. Over quite a considerable part of the areas of Manhattan, Brooklyn and The Bronx where poliomyelitis has been prevalent, the dwellings form entirely, or almost entirely, completed blocks of this kind.

When districts of this kind are plotted for poliomyelitis, it is seen that the distribution of cases is by no means regular; such could hardly be expected with so few cases occurring over a small area. There is shown, however, quite a distinct tendency for the cases to group themselves more or less definitely in certain blocks while others of similar construction, and supporting a similar population, remain entirely free from the disease. This tendency is well illustrated by several maps (pp. 165-169) taken from a district on the middle west side of Manhattan where there have been a number of small foci of the disease. In the first map (A), two adjacent city blocks are seen to be heavily infected, having seven and eleven cases respectively, divided between two sides of each block, while the contiguous ones have entirely escaped as indicated. In another group (B), one block has suffered seven cases, while in the adjacent blocks only a single one appears across the street from the group of seven. In the third group (C), one block contains five cases, occurring on both sides of the block, while the adjacent ones are free from the disease. In this same small area, three cases appear along the northern side of the lowest block, but none across the street. In the fourth group one block contains six cases, distributed along one side, while the adjacent one has three, only one of which apparently bears any relation to those across the street.

It is not easy to put such data upon a statistical basis, but so many groupings like those figured have occurred that it does not seem possible to ascribe them to chance. It is very evident that they do not correspond with the more common movements of children which would bring them into contact with other children. Such association in playing is more apt to happen between neighbors across the street than it is with those living down the block, around the corner or on the next street (of Fig. 1-A). It is also not easy to believe that any human carrier or any flying insects would show the type of movement or migration necessary to produce case distribution of this kind. It is, however, easier to believe that rats, or even domestic cats might easily migrate in this fashion by the way of yards or back fences. It may be mentioned here that dogs are not generally present in the tenement house districts.

These maps bring out another interesting fact. It will be seen that in the few blocks represented, five houses have had more than one case (4 houses with 2 and one with 3). Multiple cases almost invariably occur in blocks with other cases; that is to say, it is very unusual to find two cases in a single house or family without additional cases somewhere else in the block.

We thus see that there is a tendency for certain blocks to become centres of infection, and that the chances of second cases appearing in families is enhanced by, and seems almost dependent upon, the presence of other cases in the block. This, coupled with the entire absence of the disease in so many blocks adjacent to infected ones is hard to understand on the basis of a healthy human carrier or of flying insects.

Since a large part of the cases of poliomyelitis have occurred in blocks that are used exclusively for dwellings, it has been possible to observe what relation stores, stables, etc., may bear to individual cases. This cannot be satisfactorily tabulated on account of the almost innumerable degree of association with one type or another of food-shop, market, delicatessen, restaurant, bakery, stable, etc., and we have had to rely on impressions gained during the examinations of districts, supplemented by notes made concerning individual cases. The following list is typical of one of the somewhat better districts where there has been a group of scattered cases in The Bronx.

Case 1. Poultry and meat market in building (Tenement).*
Case 2. Candy store next door (Tenement).
Case 3. Poultry and meat market in building (Tenement).
Case 4. No shops or stables (1½ story old wooden building).
Case 5. No shops or stables (Tenement).
Case 6. Stable next door (2 story old wooden house).
Case 7. No shops or stable (old 3 story brick house).
Case 8. Grocery, candy store, laundry in building (Tenement).
Case 9. No shops or stable (Tenement).
Case 10. Bakery and lunch room next door (old 3 story wooden house).
Case 11. Grocery and dairy in building, candy and ice cream store next door (Tenement).
Case 12. Bakery next door (Tenement).

A second area in Manhattan was as follows:

Case 1. No shops or stable (Tenement).
Case 2. Over delicatessen shop, stable 2 doors away (Tenement).
Case 3. Over stable (brick house).
Case 4. Over ice cream store, macaroni factory next door (Tenement).
Case 5. Delicatessen store next door (Tenement).
Case 6. Over junk shop, grocery next door (Tenement).
Case 7. Grocery on one side, saloon on other, with meat market next (Tenement).
Case 8. Over vacant basement grocery, basement grocery next door (Tenement).
Case 9. Vegetable store in one half of basement, grocery in other (Tenement).
Case 10. No shops or stable (Tenement).
Case 11. No shops (Tenement).
Case 12. Over meat market, adjoining buildings not dwellings (Tenement).
Case 13. Over meat and provision store, "Pork" store next door (Tenement).
Case 14. No shops nearer than market two doors away (Tenement).
Case 15. Over undertaker's shop (Tenement).
Case 16. No shops or stable (Tenement).
Case 17. No shops or stable (Tenement).
Case 18. Grocery next door (Tenement).

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* The word tenement is used only for large buildings of four to six stories, each housing numerous families.

There seems to be a well marked tendency for cases in Manhattan to appear in the immediate vicinity of stables, groceries, meat or poultry markets, lunch rooms, delicatessen shops and bakeries or macaroni factories. The kind of stores vary, of course, with the neighborhood, and some of the sorts mentioned do not occur in every district. However, it is surprising with what regularity one or the other is found in the building or next door to a house in which poliomyelitis has occurred. Others who have also examined the same districts with an unbiased mind, seem always to believe that cases range themselves with a definite relation to shops of this type. It has been repeatedly pointed out in earlier epidemics that stables are often associated with cases of poliomyelitis. This has been undoubtedly true in New York during the present summer, but the other association with provision shops has also forced itself upon our attention.

In combination with other observations, the present ones are interesting. Association with stables at one time appeared suggestive in connection with the fact that stable flies might be the carrier of poliomyelitis. Stables support rats as well as stable flies, and as food shops support the former, but not the latter, this is another bit of evidence pointing toward the rat, or perhaps the domestic cat, as these animals are maintained in particularly great abundance in shops of the kind under consideration. It is a generally accepted idea that the presence of cats serves to keep buildings free from rats. This is erroneous as has been abundantly shown by various observers who have found rats and cats commonly occurring together, both in buildings and on shipboard.

In more or less close connection with this matter, there is another which is brought out in our notes taken of individual houses. In the table given on page 150 it will be noted that several cases occurred in wooden buildings. It happens in this district that these buildings scattered among blocks of tenements are relics of a period before the neighborhood was engulfed by the City. These buildings house an insignificant number of persons compared to the tenements, yet they have suffered considerably from poliomyelitis. This is only an isolated example, but is typical of the fact that so far as one can form an opinion by careful observation and reflection, it is the older or more poorly cared for, particularly wooden houses without cemented basements, which suffer most severely. Thus, the house next door, is so frequently found to be at least noticeably better than the infected one, either newer, of better construction, kept in a more cleanly condition, or in better general repair. There are, of course, exceptions, many due as nearly as one can tell to the association with shops mentioned above. In certain parts of Brooklyn, where houses of different ages and types of construction are grouped together, examples of this kind have been especially striking, but it must be repeated that exceptions are by no means uncommon.

The Grouping of Cases in Individual Houses—

In going over areas where poliomyelitis has occurred in the City, one gains the impression that there is a tendency for the cases to be more abundant on the lower floors of buildings. It has been possible to examine this matter statistically, and also to compare the distribution of poliomyelitis with scarlet fever and diphtheria in this respect. For this purpose, the Borough of Manhattan was selected since only a negligible percentage of the buildings used as dwellings are less than four stories in height. The vast majority of the population is housed in buildings of four and five stories, so that the number of cases occurring on the various floors, should show whether the incidence of the disease really bears a relation to the floor upon which the families live.

For a check, two diseases, scarlet fever and diphtheria, known to be spread by personal contact and to some extent by apparently healthy carriers were chosen. The way in which these latter two diseases are apportioned to the various floors of dwellings in Manhattan during the late Spring and early Summer of 1916, and the distribution of poliomyelitis during the epidemic, is shown on the accompanying charts (pages 171 and 173).

These data are somewhat difficult to interpret as in a number of cases the floor is given as " top " instead of by number. Some facts are, however, clearly evident. On the first floor, there are fewer cases than on the second and third floors, as quite frequently there are stores or places of business on this floor, which reduce the number of available dwelling places. It is seen that 17.9 per cent. of the cases of poliomyelitis were on the first floor, against 12.9 and 11.8 for diphtheria and scarlet fever respectively. On the basement, first, and second floors together, the number of cases of poliomyelitis has been greater and on the third and higher floors together it has been lower, than in the case of either diphtheria or scarlet fever, as is shown in the following table taken from the chart. A very few cases on higher floors and in private houses are omitted; they amount to only 1% of the entire totals.

Basement, 1st and 2nd Floors.		Third and Higher Floors.	
Poliomyelitis	44.3%	Poliomyelitis	54.1%
Diphtheria	39.9%	Diphtheria	58.9%
Scarlet Fever	37.0%	Scarlet Fever	60.5%

In Brooklyn there appears to have been an even greater tendency for the cases of poliomyelitis to be more abundant on the lower floors of dwellings (page 175). Here, however, on account of the number of buildings of only two stories, it is impossible to make a dogmatic statement.

It can be seen that poliomyelitis has been consistently more abundant on the first two floors, and less abundant on the higher ones. This difference implies an infective agent which is more prevalent near the ground; the only other plausible assumption would seem to be that the disease is favored more by the lack of air and light on lower floors than are scarlet fever and diphtheria. This greater prevalence on lower floors is also easily explained by an insect carrier such as various flies and mosquitoes, or by an association with rats or cats. In the case of the rat it would seem that the difference should be more marked. This, however, is only an opinion, not based on actual facts. Rats do commonly occur on the upper floors of buildings, but presumably in lesser abundance than on the lower ones. In this connection it is noticeable than in children under one year old, at which age it is probable that they play more regularly in the apartment in which they live, the divergence between cases occurring on lower floors and upper ones is greater than in older children, who, it may be expected, spend more of their time down stairs or on the street. The following table illustrates this point:

	Age Under 1 Yr.	Age Over 5 Yrs.
Basement, 1st and 2d Floors	49.3	44.8
Third Floor and above	50.6	55.2
Number of Cases	227	301

In over 500 cases about which data is available, there is a difference of 5% in the number of cases occurring in the lower and upper division of buildings, when we compare very young children and those of considerable age. This is additional evidence that there is actually a selection of lower floors and that this selection is due to the failure of the infective agent to attain the equal prevalence on higher floors.*

Houses in Which More Than One Case Has Developed—

Some very interesting data which bear upon the possibility of insect transmission are brought out by an examination of the distribution and sequence of the cases in houses and in families where more than a single case has occurred. The number of such instances is smaller than happens with most of the acute infectious diseases of childhood. This fact may be satisfactorily explained in several ways, and in itself furnishes no evidence of value. The greatest number of additional cases which occurred in families have had an onset coincident with that of the first, and the number of additional cases has decreased almost uniformly from day to day until after a fortnight a second case almost never appeared. This may have been due to the quarantine measures adopted, which have usually included the removal of the patient to a hospital. In fact the same behavior is shown by scarlet fever, which, together with poliomyelitis is graphically represented on the accompanying chart (Fig. 5). That this may not be true, however, is suggested by the fact that the appearance of the later cases in the same house, but not in the same family does not follow the same curve, but that with the exception of a single drop on the third day, it has dropped much more gradually. Another noteworthy fact is that the number of cases appearing in the same building, but in another family or apartment, is far greater in this epidemic of poliomyelitis than has occurred in 1916 with either scarlet fever or diphtheria. The latter disease has not been included on the chart, but the following table shows the apportionment of later cases by houses and families for the three diseases.

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* This study is incomplete and the conclusion therefore not fully justified owing to the fact that no count was made of the children of the specially susceptible ages, or the children of all ages living in apartments on the various floors of the tenements. It cannot be safely assumed that there is an equal distribution of children of all age groups on the different floors of the tenements in New York City.—[*Editor's Note.*]

	Cases in Same Family.	Cases in Same House But In Different Family.
Poliomyelitis	335 or 56%	257 or 43%
Scarlet Fever	198 or 86%	31 or 13%
Diphtheria	73 or 78%	20 or 21%

It is evident that there is a very great difference between poliomyelitis and the other two diseases in the number of later cases that have appeared in the same building, but in a different family. Thus 43% of the additional cases or nearly half appeared in the same house, but outside the family in which the original case occurred. This is more than double the number (21%) for diphtheria and more than treble (13%) the number for scarlet fever. It seems incredible that such a divergence should exist if poliomyelitis like the others were spread through infection from sick individuals or healthy carriers, and the susceptibility of the exposed individuals is the same.

The gradual dropping off of additional cases from day to day and the large proportion of cases occurring in other families in the house may be easily explained on the basis of the appearance of some non-human population in the house, not definitely restricted by the boundaries which prevent intimate association, followed by its actual disappearance or inability to cause infection after a variable length of time. So far as this evidence is concerned, this population might be composed either of insects or of higher animals such as rodents or cats.

Insects as Possible Carriers of Poliomyelitis—

As has been pointed out on the preceding pages, many facts in the epidemiology of poliomyelitis seem to show the spread of the disease to be such that it is impossible to understand its distribution without assuming either a migrating, *i.e.,* healthy human carrier, or a migrating non-human carrier, either an insect or another animal, perhaps both.

Aside from possible spread through numerous healthy adult human carriers no carefully considered hypothesis has been advanced which does not include some insect in the role of a casual or specific carrier.

There is much experimental evidence in support of the idea of contact. Thus, it has been shown that the virus of poliomyelitis can be recovered from the mouth, nose and intestines in sufficient quantity and in such conditions that it is capable of causing the infection of monkeys upon intracerebral inoculation. This recovery of the virus has actually been made, from apparently healthy persons who have been in contact with children ill with poliomyelitis. After this virus has multiplied in the central nervous system of the monkey thus infected, it is capable of infecting another monkey when implanted upon the mucous membrane of the nose. This of course suggects that human cases may result from infective nasal or buccal discharges, not gaining access to the brain directly, but through the nasal mucosa. While suggestive, this evidence is not conclusive for it is quite probable that the same procedure could be followed with the virus of rabies secured from a person afflicted with the disease. Other experimental observations upon monkeys have shown that the quantity of poliomyelitis virus present in the blood during early stages of the disease is very minute, and that considerable quantities of blood are required to reproduce the disease in another monkey. This would suggest that infection was not secured from the blood, or that if it were, an insect acting as a biological carrier and not as a mechanical one should be involved. That the virus is not more abundant in the blood of human cases in the early stages of the disease than it is in monkeys would seem probable, although by no means proved, since the experimental transfer from one animal to another is accomplished by use of portions of the infected spinal cord, and departs so widely from what must normally occur that it is possible that stages of invasion in which the blood stream plays a part may be entirely eliminated by the present laboratory methods.

It is quite possible that the virus might be obtained by a blood-sucking insect from the superficial nerves, some of which are commonly reached by the mouth parts at the time of the biting. Similarly, inoculation into these nerves could easily occur at the time of a later feeding by the insect.

As already mentioned, the evidence that insects are a factor in the spread of poliomyelitis is based to a great extent upon epidemiological evidence. Aside from facts of general application referred to in the introductory part of the report, the present epidemic has offered an opportunity to examine the spread of the disease in a totally different environment from those in which it has previously been studied. Such facts and observations have already been given as seem to bear on insects, but attention has been called to only a few ways in which they may be applied to the purpose of the present investigation. No attempt has been made to conduct an actual census of the insects present in houses or apartments where poliomyelitis has occurred, as it did not seem that such a procedure would lead to satisfactory results. It is apparent that a disease so common as poliomyelitis, if dependent upon an insect, must depend upon some abundant species. That any insect occurring in sufficient abundance to account for cases over large areas should be absent in others does not seem probable, and is not in agreement with what is known to occur in the case of other insect-borne diseases. With yellow-fever, for example, the yellow-fever mosquito (aëdes) regularly occurs over large areas (*e.g.*, the southern United States) where the disease does not exist, and it is also regularly distributed in all parts of a city (*e.g.*, Guayaquil, Ecuador), while the cases of yellow-fever occur in such a way that the comparative abundance of mosquitoes does not show a definite correlation with the number of infected ones. Such is also the case with bubonic plague, although here the greater abundance of the disease in parts of a city heavily infested with rats is evident when a number of areas are examined for rat prevalence. For this reason no census of houses has been taken in studying the present outbreak of poliomyelitis, but many circumscribed areas have been examined for the general type of insect fauna existing there.

There are three types of insects which are suited by their habits and association with man to act as carriers of human infectious diseases. One type includes such insects as lice and bedbugs. The first are epizoic parasites during their entire life and do not commonly pass from one individual to another except during close personal contact. They do not remain alive for any length of time away from their host. Such insects obviously cannot account for the spread of poliomyelitis since cases continually come to notice where a transfer of lice could not have occurred. In fact this commonly is more difficult than the transfer of infection by droplet contagion. A louse-borne disease like typhus fever also shows an entirely different epidemiology from poliomyelitis. The bedbug is less dependent upon its host as it can live for long periods without food and may thus easily change its host. However, it does not commonly migrate on its host, nor probably to any extent through tenement buildings except when impelled by the continued vacancy of apartments. It lives almost entirely on human blood and thus does not migrate on the bodies of animals. Extensive migration of such kinds as would be necessary if it were an active agent in the spread of poliomyelitis, even under conditions existing in the crowded sections of New York seem utterly improbable. In this connection it must be mentioned that the virus has actually been recovered from bedbugs that have fed on the experimentally inoculated monkeys.

Another type of blood-sucking insects which remain quite closely associated with their host are various species of fleas. These insects, like the bedbug, never develop wings and consequently do not migrate extensively through their own activities. They can live away from the body of their host for a shorter length of time than the bedbug, but so far as is known, the time during which they can remain alive depends to a great extent upon the amount of moisture present in the air or in such loose dirt, rubbish, etc., as may afford them a hiding place. They undergo their developmental stages (egg, larva and pupa) either in the nests of rodents, cats, or dogs in the case of our common household species, or in accumulations of dust and fine dirt which may accumulate in the corners or cracks of floors in dwellings. Those species which occur on the cat, dog or on rats and mice are capable of considerable migration, since they usually remain on the host animal continuously after they have reached the adult stage, and thus go with it wherever it may wander.

Until recently it was not believed by us that fleas agreed on any essentials of prevalence or possibilities of migration with what would be required of a carrier of poliomyelitis. Like many insects they were long ago suggested as possible vectors. Conn once regarded them as perhaps associated with the spread of poliomyelitis, but before enough was known epidemiologically to examine them critically. Since Richardson advanced this idea that the disease showed an apparent relation to rats in Massachusetts the flea question has received more attention. As the seasonal prevalence of fleas seems incompatible with that of poliomyelitis, it was suggested that data be secured on the relative abundance of fleas on cats during different parts of the year. From an examination of cats collected by the Boston Animal Rescue League during 1913-1914 it was ascertained that the seasonal abundance of fleas on cats corresponds quite closely to that of poliomyelitis, in fact more closely than that of the stable-fly at least during the winter. During the winter, fleas become scarce, especially in late winter and spring, attaining their minimum in this case during March, after which they rapidly increased until July at which time the observations had to be discontinued.

The persistence of fleas in smaller numbers during the winter is quite in harmony with the frequent continuance of poliomyelitis into late fall, and their rapidly increasing abundance during midsummer also coincides with the rise of the disease.

If we now compare poliomyelitis with a disease known to be spread almost exclusively by fleas and rats we find a number of striking similarities, but also some very evident differences. A somewhat hasty examination of the literature relating to the epidemiology of bubonic plague made by Dr. Freeman and the writer, tended strongly to confirm our belief that there are many similarities between these two diseases in the development of epidemic foci and the relation of the latter to scattered and more or less isolated cases. During recent times there have been no very extensive outbreaks of bubonic plague in temperate regions where the climate corresponds at all closely to that of the northern countries in which poliomyelitis has been closely studied. The progressive development of a number of small epidemics of plague that have been very carefully followed show a close similarity to epidemics of poliomyelitis in their main features of distribution. This is especially true of the first general scattering of cases, the beginning of small foci and the way in which an epidemic spreads into new territory while the original small foci may gradually enlarge. As has been shown on previous pages, many features of the distribution and spread of poliomyelitis during the present epidemic lend themselves readily to interpretation on the basis of rats. These, as enumerated and considered in detail are, the grouping of the denser foci along the various water fronts of the city, their development in many localities without definite relation to the distribution and density of the human population, the spread of the epidemic in such a way as rats might be expected to migrate, the grouping of cases in neighborhoods and in houses, etc.

The way in which the small groups of cases have appeared in certain city blocks and the marked tendency of additional cases in the same house to appear outside of the family or apartment are also more easily explained on this basis than upon that of personal contact. The greater incidence of poliomyelitis on the lower floors of the tenements and apartments is also plausibly explained in the same way.

The attempt has been made to ascertain whether rats or evidence of their presence could be found generally in houses where cases of poliomyelitis have occurred. In a great number of instances their presence has been satisfactorily shown by direct evidence such as runways or rat-holes. In others the information has been obtained by questioning residents of the buildings. The last mentioned is very unsatisfactory; in some cases there has been evident exaggeration, and in many others an equally evident desire to deny the presence of anything not considered proper, or anything for which repressive measures might be required by the Department of Health. In others the proximity of stables, bake-shops, meat and poultry stores, etc., has given strong presumptive evidence of rats in at least small numbers. Not many trapping experiments have been tried, but where attempts have been made to obtain them from apparently suitable houses where poliomyelitis has occurred, they have been successful. These rats as was to have been expected have been found to harbor fleas.

The great ease and rapidity with which rats may migrate in both city, suburbs and country have been shown by the spread of bubonic plague, and under urban conditions at least, by actual observations on marked rats. Just what opportunities for migration and to what extent rats might avail themselves of these opportunities in a city like New York is a question rather difficult of definite answer without considerable investigation. The occurrence of rats on shipboard is notorious and there is plenty of opportunity for these animals to travel along the water-front following the movements of boats. No experiments have been actually carried on in the city, but there can be no reason to doubt that such travel actually occurs. As mentioned on a previous page one small focus in lower Manhattan is closely associated with a second focus adjacent to another landing of a certain line of steamers. The apparent spread of poliomyelitis has often been seen to follow along water routes, an occurrence usually attributed to the movements of human freight. However, the fact that some of the most noticeable early foci in New York State this summer were about towns regularly visited by steamers from New York City is at least worthy of mention. More people travel by rail from New York City than by water and they reach their destinations more quickly. Nevertheless the water route has been the most rapid for the disease in this case, and the same association with ports has been noted before on occasions not within the scope of this report. Another method of travel open to rats is transportation in freight cars, either free or inadvertently imprisoned in packing cases. Plague follows the same course, and has in some cases been found to follow railroad routes.

In cities the larger sewers support a considerable rat fauna, depending upon the construction, size and condition of repair of the sewers. The older portions of the city are supplied to a great extent with systems of bricked-in sewers which commonly harbor rats, while many pipe sewers, particularly in the newer districts, offer but small opportunities for rats to escape. Another way in which they may gain access to houses is through large basement drains which open directly into the sewers without any water-trap. Whether certain streets which have been immune during the epidemic (*e.g.*, E. 116th Street) are supplied with sewers different from those on the adjoining streets, has not been ascertained.

It thus appears that rats and fleas show a number of striking peculiarities in distribution and behavior which are very suspicious when compared with the observed epidemiology of poliomyelitis.

From the standpoint of experimental evidence there is no positive support for the contention that the two are associated. No published reference to paralyzed rats has been made, but we have every reason to suppose that these animals are subject to paralytic diseases such as are known commonly to occur in various frequently observed domesticated animals like cats, dogs, horses, cattle, etc. In none of these animals, however, has it been possible to show that such paralyses as have been observed are identical with poliomyelitis. If we knew that no animal was susceptible, and that none could act as a reservoir for the virus the situation would be much clearer. To deny that animal reservoirs exist is taking much for granted, particularly as it is very probable that even in children a large number of abortive non-paralytic cases occur. That such cases should be the prevalent type in some animal acting as a reservoir is at least perfectly plausible, and we should not expect to find the virus readily recoverable in large quantities from the unaffected spinal cord of non-paralytic animals. Since the spinal cord is the portion of the body usually taken for test, animal reservoirs might easily escape attention unless searched for with great care.

Before leaving the discussion of fleas it should be noted that these insects were not eliminated in the experiments referred to elsewhere, where poliomyelitis was apparently transmitted successfully from monkey to monkey by the bites of the stable-fly.

The second type of insects suited to act as vectors for pathogenic micro-organisms are various actively flying species of blood-sucking habits. The most prevalent forms are mosquitoes and a number of allied flies belonging to several families, gad-flies belonging to the family Tabanidae, and the stable-fly and a few allies belonging to the family Muscidae. No others have a sufficiently wide distribution and occur regularly in all of the regions and localities where poliomyelitis has become epidemic.

The status of the stable-fly has been already mentioned and has been dealt with in detail in other publications. It may be pointed out that the epidemiological evidence which so strongly incriminated this insect in studies of epidemics in smaller cities and in towns and villages does not apply with the same force under conditions existing in New York City. Like other flying insects, its behavior and comparative abundance is not compatible with the observed distribution and spread of the disease as enumerated elsewhere. Viewed in the light of the present epidemic, it seems equally easy to explain at least most of the previous epidemics on the basis of rat and flea infection, and much easier to understand the development of this summer's outbreak in New York City on the same basis.

Mosquitoes and their relatives do not seem to offer any promising lines of investigation. So far as our present knowledge goes there is no reason to believe that any of them could account for the conditions existing during the New York epidemic. They vary greatly in prevalence in different parts of the city, and while their relative abundance agrees more or less with the general trend of the epidemic, it is difficult to understand the definite foci which have developed, and gradually enlarged with so little change in shape and position. Like other flying insects, the movement of mosquitoes in the country is considerably like that of poliomyelitis, but not so in the city. This statement would not apply to a truly domestic species, like the yellow-fever mosquito (Aëdes), but this species and the Filaria mosquito (*Culex-fasciatus*) are notable exceptions. The common rain-barrel mosquito (*Culex-pipiens*) is the nearest approach to this habit among our northern species. It is not generally prevalent in a city like New York.

Certain conditions existing in some localities where Tabanid flies of the genera Tabanus and Chrysops are abundant has made it seem possible that these insects might act as carriers of poliomyelitis. The larger species are most abundant along the ocean beaches where these adjoin salt-marsh areas, along rivers, streams and ponds, or about stables, dairies, etc., where large animals are housed. The smaller species (Chrysops) occur almost exclusively in wooded areas and bite man commonly about the head and ears in all of our country districts. Like the stable-fly these flies feed normally upon the blood of animals of various kinds, but with the exception of the largest species, commonly bite human beings also. An extremely annoying species is abundant on the beaches where it goes by the name of "greenhead" on account of its large brilliant green eyes. It is a very persistent and vicious biter. These flies have previously not been free from suspicion as possible carriers of poliomyelitis because of their general prevalence in the country and their abundance on the beaches which are visited so regularly by enormous numbers of persons with children. It is very easy to find that children have recently visited a beach resort and to be led to think that the visit is related to infection with poliomyelitis. The numerous small foci described on an earlier page preclude the possibility that poliomyelitis is usually contracted so far away from home as at the beach, and the lack of outbreaks of greater size in the summer beach camps, is additional evidence. However, these flies frequently occur about stables, even in the centre of the city, where they have evidently flown for considerable distance, since the species breed in marshy lands about streams, ponds, etc. They are attracted only to living animals, however, and do not occur about markets or food shops. Since their bite is severe, it is usually remembered, but only one definite history of a bite of this kind can be recalled after visiting many families where poliomyelitis has occurred in the several boroughs. This does not include beaches; there they are by no means uncommon.

The house-fly has been very frequently mentioned as a possible carrier of the poliomyelitis virus. Its activities have been supposed to be accessory to contact infection from person to person through the medium of the nasal secretions. The flies could of course also secure the virus from fecal discharges or from the secretions or excreta of animals if it exists in such places. In any case they could act only as accessory to some other method of infection. occurring, for example, through the nose or mouth, since flies are attracted to the mouths and noses of very small children as well as to an unprotected wound or surface lesion of any kind. Food might of course become infected in the same way. House-flies may thus be called upon to explain a large percentage of cases where direct contact or carrier infection cannot be shown to have occurred. It is very difficult to analyze a combination of possibilities of this sort, as one sees by recollecting the widely variant views which have been held till recently concerning the relative importance of the house-fly in disseminating the typhoid bacillus. With poliomyelitis the situation is much more difficult on account of lack of knowledge, of many of the important factors concerned. It appears, however, that the numerous differences in the abundance of house-flies in certain sections of the city ought to be definitely reflected in the incidence of poliomyelitis if this insect be a factor. This is not the case, so far as has been ascertained. There are a number of streets very heavily supplied with flies, attracted to pushcarts full of vegetables and other sorts of food, in certain parts of the lower east side. Adjacent to these streets are others where there is no special attraction for flies. There has been no excess of poliomyelitis on such "fly-streets." Flies cannot readily account for the restriction of the disease to blocks either, since flies should show at least as great a tendency to cross the street as to travel along a block or to cross through it into the buildings on the near side of the next street. It is also difficult to see why they should not cause the larger foci, which involve areas including a number of adjacent blocks, to spread more diffusely into the surrounding territory than has actually been seen to be the case. At any rate we should have to regard the house-fly as only a contributing factor, additional to spread by contact. That it should act as it does in typhoid-fever by contaminating food is an assumption not supported by any evidence. The failure of certain outbreaks to disappear with the house-fly in the cool months speaks against it as a factory also. The persistence of the present epidemic in Massachusetts is a case in point.

The only other Arthropods suited to convey infections of warm-blooded animals are the ticks and their allies. So far these insect-like animals have been shown to carry only Spirochetae-Piroplasmata and similar organisms. They can be absolutely eliminated as far as human infection of poliomyelitis is concerned.

The development of epidemic foci of large size in various parts of the eastern United States apparently as the direct result of introduction of the infection from New York City this summer, throws new light upon the peculiar restriction of poliomyelitis to the summer months. This also supplements and confirms observations on the course of the New York City epidemic in the various boroughs.

It is evident that the course of the epidemic has been at first gradual and later has shown an increased rate of acceleration till the maximum daily incidence is reached; after this the decline has followed an inverse direction. In New York City this rate of acceleration has been greatest in the Borough of Richmond, producing a higher incidence in this borough till late in the season when its incidence was exceeded by that of the Borough of Queens. This rate seems to be much more rapid in the more rural portions of the city, even in the more sparsely settled portions of the Bronx. It is also very evident that the early start of the Brooklyn epidemic is casually related to its earlier decline, while the subsequent appearance of the epidemic in Manhattan and Bronx is resulting in a later decline in these boroughs, in the same order as that in which they were attacked.

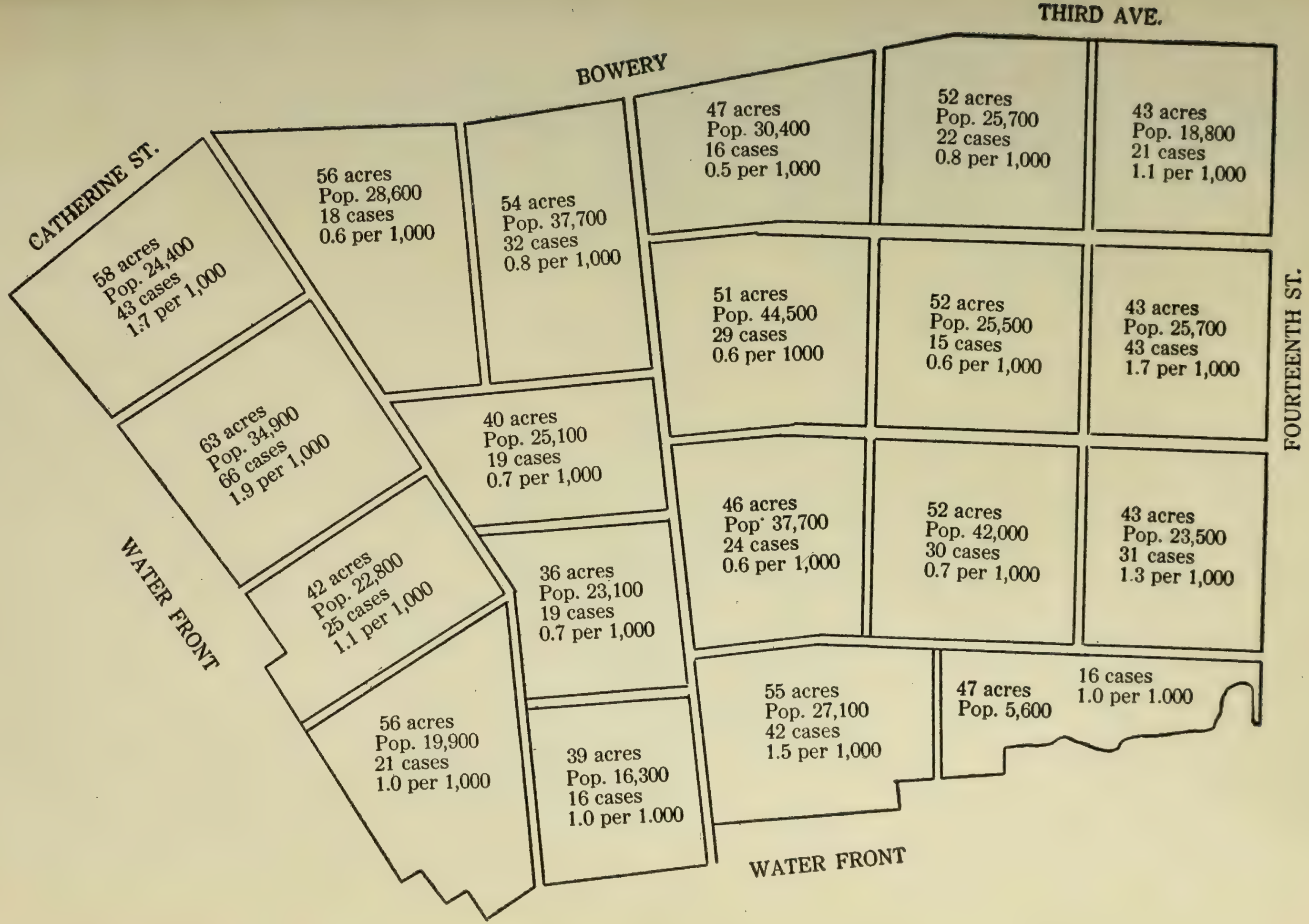
This makes it appear almost unquestionable that there is a very definite period required for an epidemic to develop and subside and that this period has been almost identical in length this summer for the several boroughs. When this is taken in connection with the late development of the epidemic in Massachusetts and its later persistence in that state in spite of cooler weather than prevails in New York, it is seen that summer epidemics are not regulated by temperature nor by insect prevalence alone. It seems equally evident that one or more factors necessary to produce an epidemic are not present in the winter except in very rare instances. However, once an epidemic has started, it appears to run its definite predetermined course even though this may be prolonged much later in the season in New England than in southern New York. From these facts it would seem that any insect responsible for the spread of poliomyelitis, must be one which remains prevalent much longer in the autumn than the time at which epidemics usually disappear. The stable-fly and fleas of various sorts would fit this requirement, The majority of other insects do not appear to do so satisfactorily on account of their more rapid disappearance upon the approach of autumn in our climate.

CONCLUSIONS.

Some new facts of interest and importance relating to the possible transmission of poliomyelitis by insects have resulted from the present study, but these are not so definite or complete as had been hoped. They are also to some extent of apparently conflicting nature, and require at least one unproven assumption to combine them into any working hypothesis. They do not completely disprove the idea that the stable-fly (*Stomoxys calcitrans*) is implicated, although the behavior of the present epidemic does not favor this view. To discard it is to cast aside evidence derived from two sets of experiments, however, and it seems very unwise to do this at the present time of uncertainty. As has been shown, it is possible with one assumption to form a working hypothesis based upon rats and fleas which seem to fit the epidemiological observations in general features and in many details as well. The assumption that the rat can act as a reservoir for the virus of poliomyelitis should be capable of experimental proof, and it would seem that such experiments should be attempted.

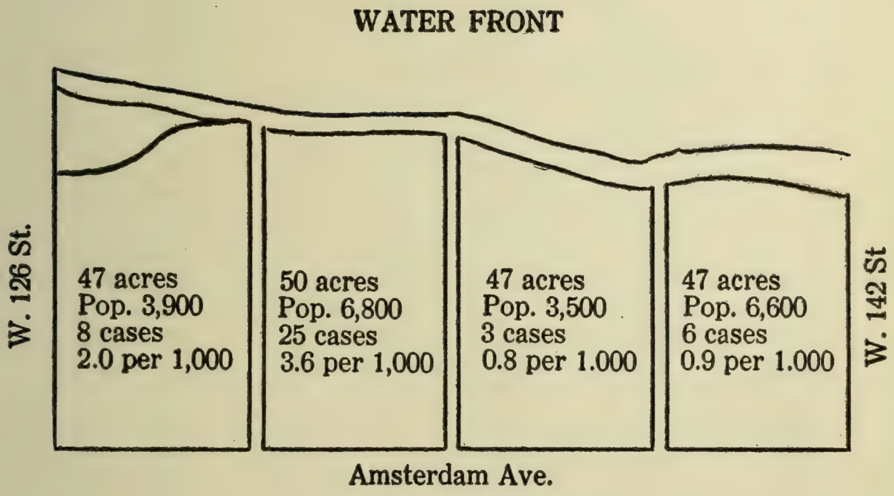
This by no means precludes the association of some other insect or warm-blooded animal, or both. In fact, there is a continual appearance of circumstantial evidence that suggests a population other than the human one, acting as an undercurrent and influencing the progress of the epidemic.

When the many factors so far in doubt are gradually made known, it will be possible to attack the entomological side of the question with better promise of success. Among the unknown factors which cause the greatest confusion in interpreting epidemiological evidence are (1) the length of the period of incubation (2) the number of mild, abortive or unrecognizable cases and carriers of the virus and their relation to infection and immunity; (3) the duration of infectivity in clinically recognized cases; and (4) positive knowledge of the presence of the infective agent in insects, domestic animals, or other possible intermediate hosts or reservoirs of the virus.



Population 539,300; 545 cases; incidence 1.01 per 1,000.

Map 1.—Part of the lower east side of Manhattan, showing the area, population and incidence of poliomyelitis in the several sections.



Population 20,800; 42 cases; incidence 2.0 per 1,000.

MAP 2.—Area on the upper west side of Manhattan where there was an extensive outbreak of poliomyelitis.

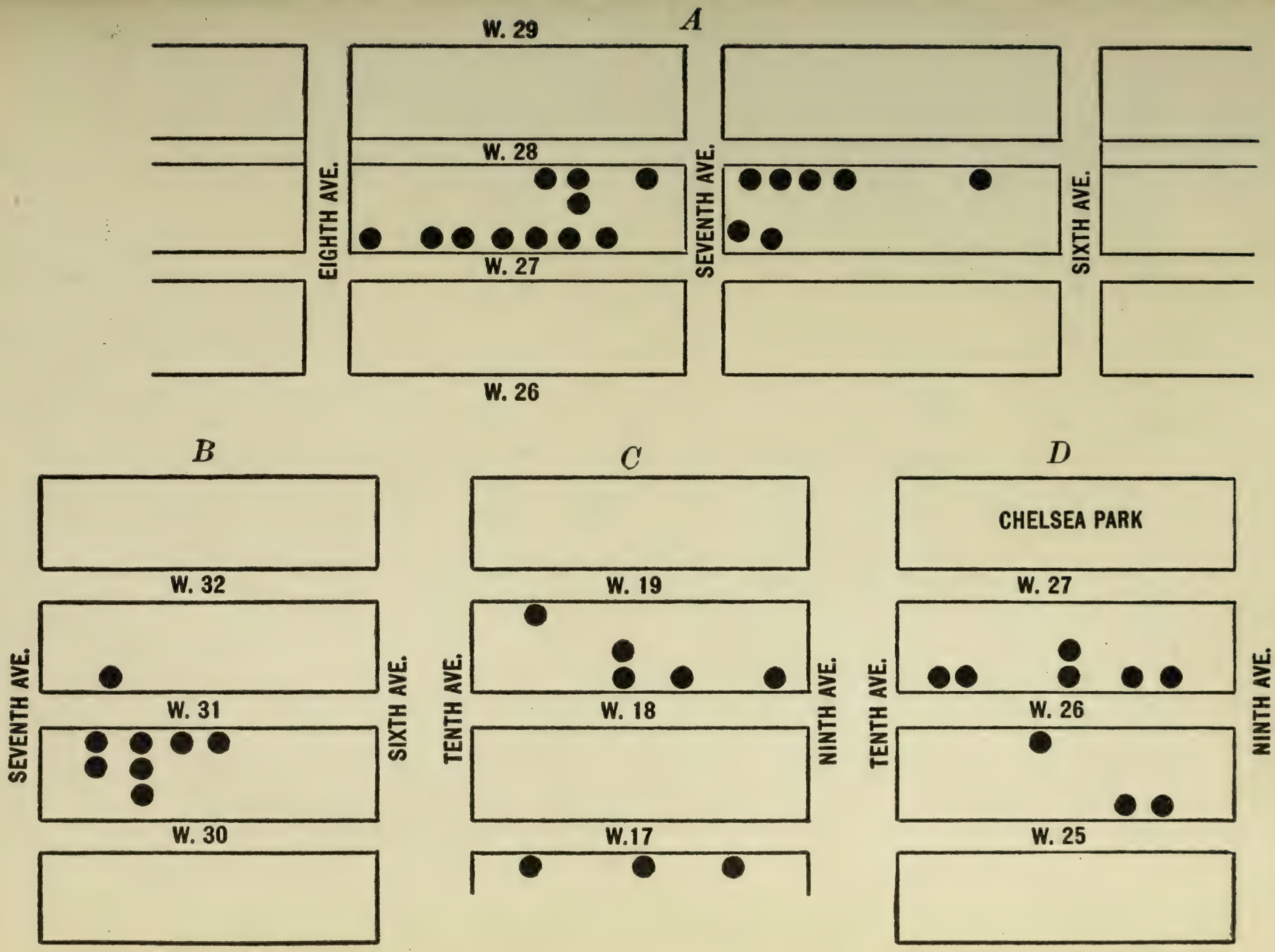


FIG. 1.—Four groups of cases of poliomyelitis on the west side of Manhattan, illustrating the typical grouping of cases. Each dot represents one case; those along the street show the approximate position of the house and those away from the street, additional cases in the same house.

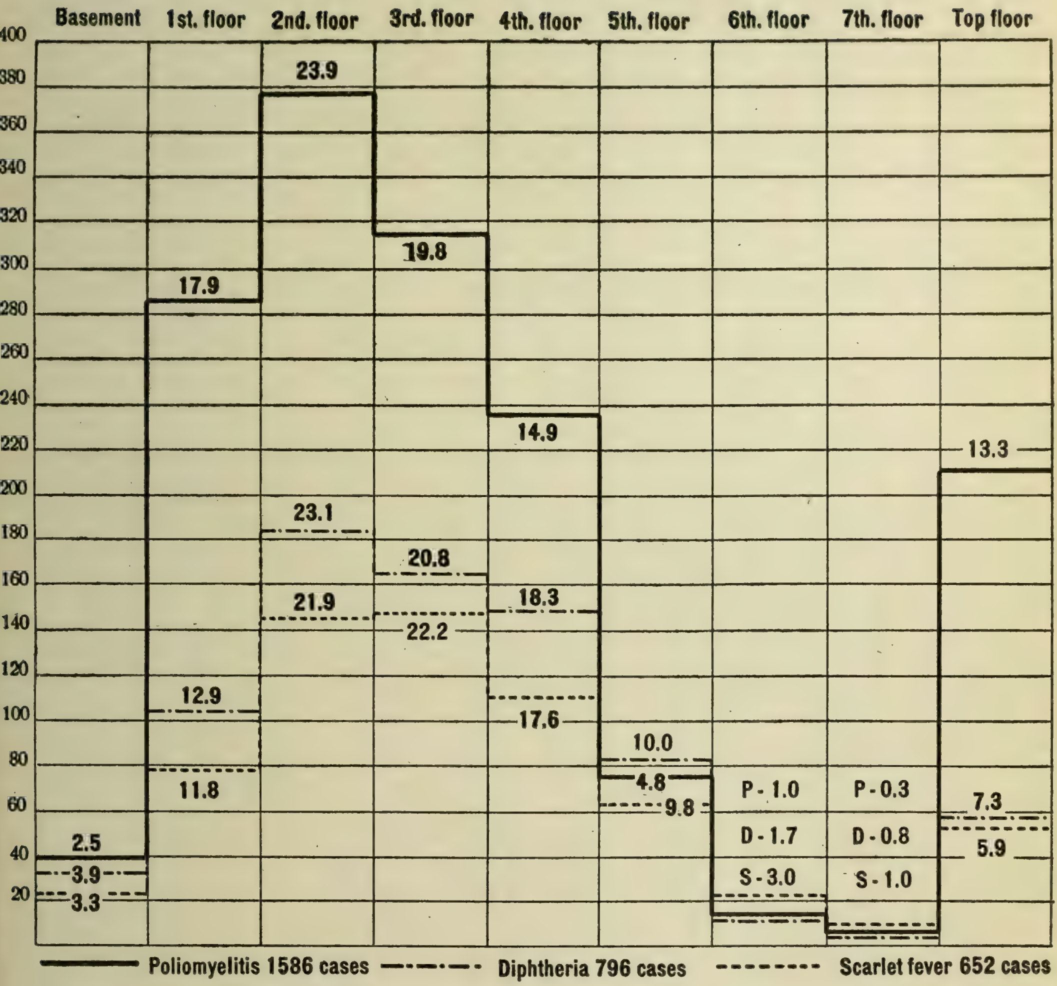


FIG. 2.—Chart showing the prevalence of poliomyelitis, diphtheria and scarlet fever on the various floors of dwellings in Manhattan. The number of cases is shown by the figures at the left of the chart, and the percentage of cases upon a given floor is shown by the figures placed in the vertical columns.

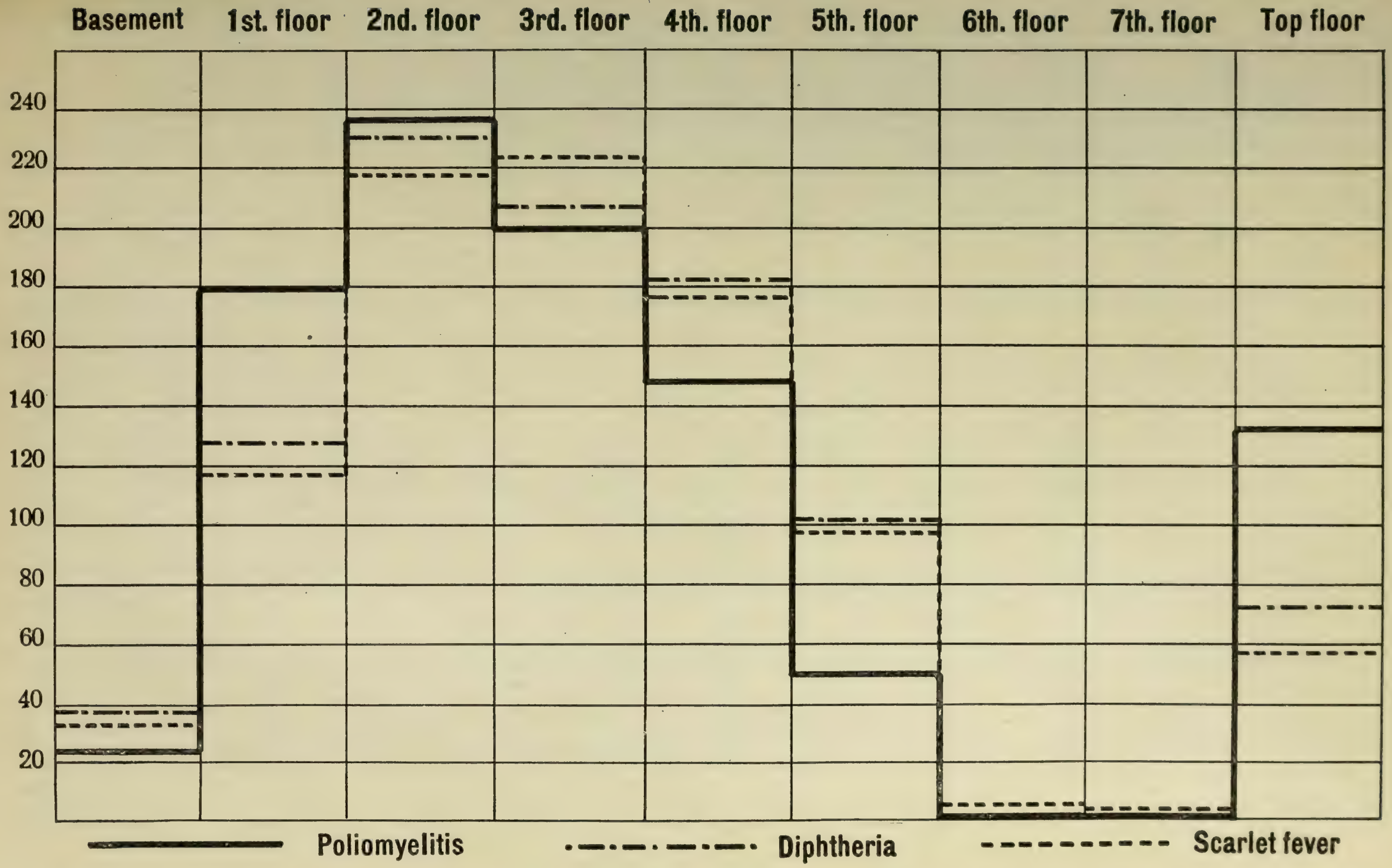


FIG. 3.—Chart showing the prevalence of poliomyelitis, diphtheria and scarlet fever on the various floors of dwellings in Manhattan. The lines representing each disease are reduced to the same scale, the numbers at the left representing tenths of one per cent.

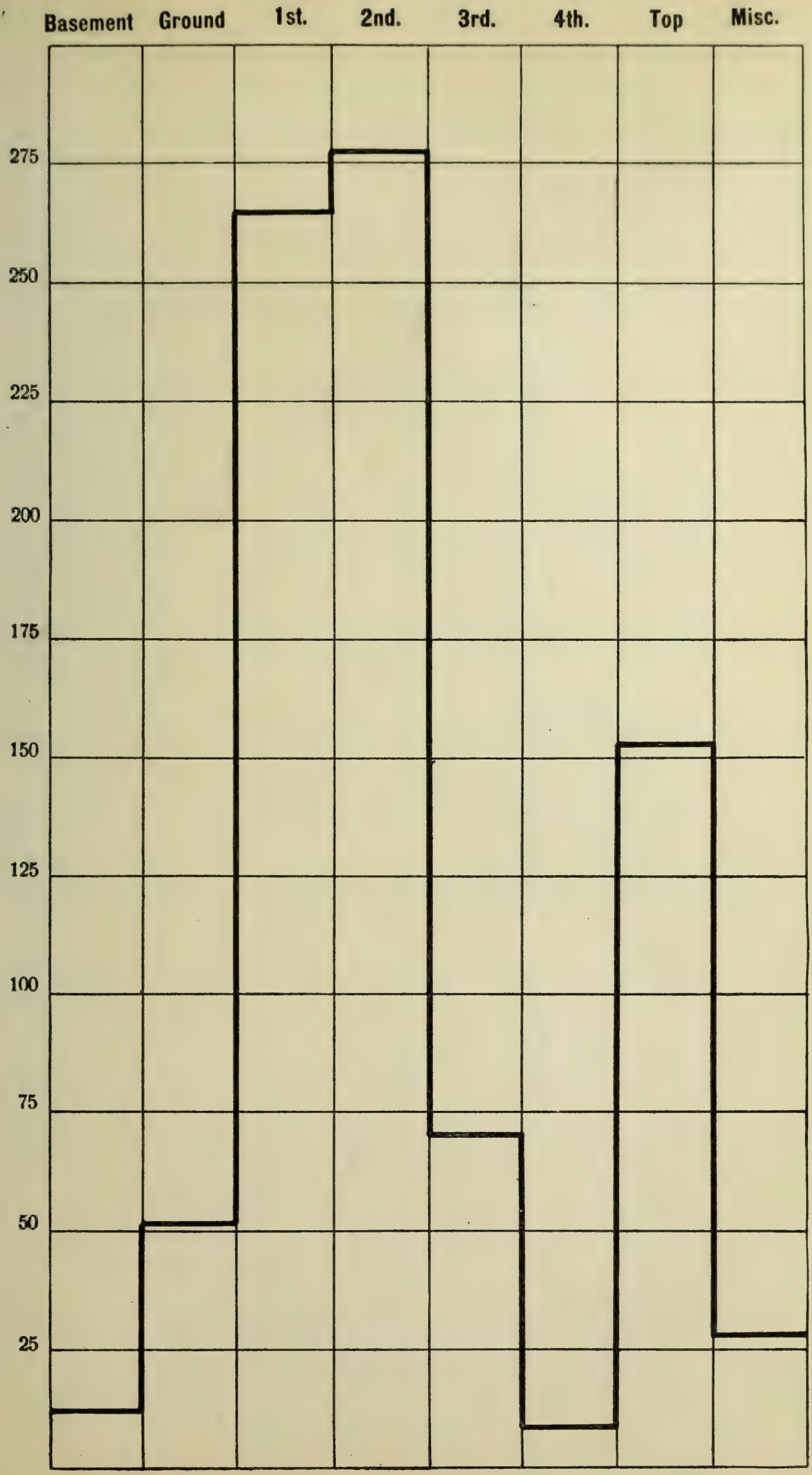


FIG. 4.—Distribution of 857 cases of poliomyelitis on the various floors of dwellings in Brooklyn. Figures at the left indicate number of cases.

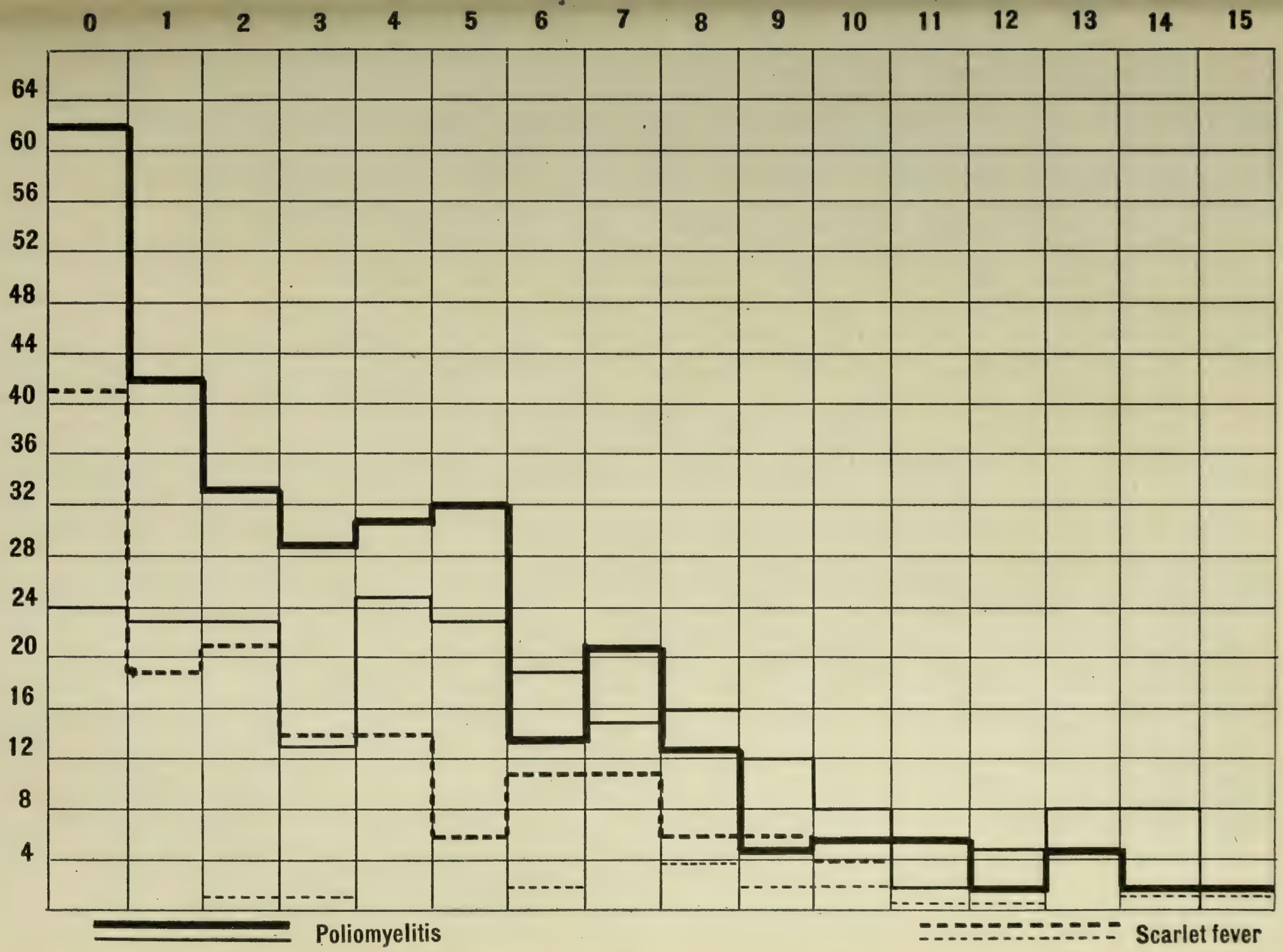


FIG. 5.—Chart illustrating the relation of additional cases of poliomyelitis and scarlet fever to first cases in the same house. Thick lines indicate additional cases in the same family and thin lines denote additional cases in the same house but in a different family. The actual number of cases is indicated by the figures at the left of the chart. The figures at the top of the chart show the number of days elapsing between the onset of the first case and the onset of the additional one. Thus 62 additional cases had their date of onset coincident with that of the first case, 42 were one day later, 33 two days later, etc.

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THE TEMPORARY SOCIAL PARASITISM OF LASIUS SUBUMBRATUS VIERECK.[1]

By William Morton Wheeler.

During the past summer, while studying the ants of the Sacramento Mountains, at Cloudcroft, N. M. (alt. 9,000 ft.), I had an opportunity to observe the method of colony formation employed by *Lasius* (*Formicina*) *umbratus* Nyl. subsp. *subumbratus* Viereck. *L. umbratus* has long been known as a circumpolar species comprising several races, or subspecies and varieties, the names and known geographical distribution of which are recorded in the following list:

Palearctic Forms.

L. umbratus subsp. *umbratus* Nyl.	Northern and Alpine Eurasia from Britain to Japan.
subsp. *mixtus* Nyl.	
var. *mixto-umbratus* Forel	
var. *umbrato-affinis* Ruzsky	Russia.

Nearctic Forms.

subsp. *mixtus* var. *aphidicola* Walsh	Canada, Central and Atlantic States.
subsp. *subumbratus* Viereck	British America, Rocky Mts.
subsp. *speculiventris* Emery	Known only from New Jersey.
subsp. *vestitus* Wheeler	Known only from Idaho.
subsp. *minutus* Emery	Central and Atlantic States.

In Europe, according to Wasmann and Donisthorpe, the var. *mixto-umbratus* is more common than the typical *umbratus* or *mixtus*, between which it is intermediate in size, color and pilosity. In the Eastern United States *aphidicola* is certainly the most abundant form of *umbratus*. The subspecies *speculiventris* and *vestitus* are imperfectly known, the latter from a single female specimen, the former only from the types taken many years ago by Pergande at Caldwell, N. J. The subspecies *minutus* is very sporadic. During the past eight years I have found only a single colony of it in the vicinity of Boston. The types of the subspecies *subumbratus* were taken by Professor Cockerell at Beulah, N. M. (alt. 8,000 ft.). I have taken it at Williams, and on Mt. Lemmon in the Santa Catalina Range (9,000 ft.), Ariz., at Cloudcroft, N. M. (9,000 ft.), Lake Tahoe, Calif. (8,000 ft.), near Ottawa, Ontario, and Hull, Quebec and have seen specimens from Digby and Bedford, Nova Scotia. It is therefore the most boreal and stenothermal of all the North American subspecies of *umbratus* and, as I have stated in a former paper (1917), properly belongs to the Canadian zone.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 136.

To the ethologist *umbratus* is of unusual interest, because in Europe it is a temporary parasite of *L. niger* and in turn serves as the host of *L.* (*Dendrolasius*) *fuliginosus*, which is therefore a true temporary social hyperparasite. The young *umbratus* queen is adopted by a colony of *niger* workers, which bring up her brood. Eventually these workers die off, probably in the course of four or five years, and the *umbratus* colony, now pure, becomes very populous. Then it may in turn adopt a queen of *fuliginosus*, the offspring of which eventually supplant the *umbratus* colony. In both cases the host queens are eliminated, probably by being assassinated either by their own workers or by the parasitic queens. The various phases in the development of the *umbratus* and *fuliginosus* colonies have been studied by European myrmecologists. The occasional occurrence of mixed colonies of *umbratus* and *niger* and *umbratus* and *fuliginosus* was noted by Schenck, Adlerz, Forel, Wasmann and de Lannoy, but Emery and Forel in 1908 first suggested that they might be interpreted as arising from temporary social parasitism. Later Crawley and Donisthorpe fully demonstrated the truth of this conjecture by showing that the typical *umbratus* is parasitic on the typical *niger*, the subspecies *mixtus* on the subspecies *alienus*, and that *umbratus* regularly functions as the temporary host of *fuliginosus*.

Although North America is so rich in *umbratus* forms, no one has hitherto been able to prove from observations in the field that any of them is parasitic on some one of our varieties of *L. niger.* I have repeatedly found deälated queens of *aphidicola* in small cavities under stones as if in the act of founding colonies independently in the same manner as most ants, but never with brood. Nor have I ever been able to find a mixed colony of *L. niger* var. *americanus* and *aphidicola*, even in Illinois where both forms are common in the same localities. The only indication that any American form of *umbratus* may be a social parasite is furnished by some specimens of *subumbratus* collected by Mr. W. Reiff in Nova Scotia and some experiments by Tanquary on *minutus.* At Bedford, near Halifax, Mr. Reiff took six deälated *subumbratus* queens from three colonies of what I recorded at the time (1910) as "the large yellowish form of *Lasius niger* var. *neoniger* Emery." Since the discovery of Pergande's types of Alaskan ants I can now state definitely that this variety is *sitkaësis.* As Reiff's specimens were not accompanied by notes, the parasitism of *subumbratus* could only be conjectured. Tanquary introduced successively some eighty-eight of the small, active queens of *minutus* into twenty different colonies of *L. americanus, nearcticus, brevicornis, claviger* and *interjectus* and obtained one case of adoption. This was in a colony of eight workers and a large number of cocoons of *americanus.* He concludes that "although one adoption out of 88 attempts is a small percentage, yet I think the ease with which this queen was adopted is very suggestive, and taken together with the facts mentioned above, namely the sporadic occurrence of the species, the very large number of females produced, the small size of the females, the fact that these females have not been seen in the act of founding a colony and one additional fact that may be mentioned, the mimetic coloration of the females (the color of these females is exactly the same as that of the darker form of *americanus*), I think justifies us in concluding that the queen of this species is in all probability, temporarily, parasitic upon the common *L. americanus.*"

My observations at Cloudcroft leave no doubt concerning the parasitism of the subspecies *subumbratus* on two forms of *L. niger,* the var. *sitkaënsis* Pergande and the var. *neoniger* Emery. The former, as I have recently shown (1917), is the common form of *niger* at higher altitudes and latitudes from Alaska to Maine and Nova Scotia and southward along the ranges of the Sierra Nevada and Rocky Mountains. The worker and female of this variety are large, brown or yellowish brown, with numerous erect or suberect hairs on the legs and antennal scapes. It passes over into the var. *neoniger*, which is smaller and darker, but has hairy legs and scapes, unlike our common and more xerothermic var. *americanus*, which closely resembles the European *alienus* in having the legs and scapes merely finely pubescent. At Cloudcroft *sitkaënsis* is everywhere abundant in the pine forests at an altitude of 9,000 to 9,500 feet, and nests by preference under large stones. The females and workers have a peculiar and rather agreeable aroma, which is much stronger than that of *americanus* and much like the odor of *subumbratus*. On rocky slopes, exposed to the sun, especially along the edges of the alpine meadows, the typical *sitkaënsis* is replaced by *neoniger* and forms intermediate in size and coloration. At altitudes of 7,000 to 7,500 feet or at higher elevations in very warm, dry situations the var. *americanus* and forms transitional to *neoniger* are not uncommon. At Cloudcroft I failed to find *subumbratus* below 9,000 feet. Its colonies are very populous and live under large stones, usually in the shade of the pines. Its habits, like those of the other subspecies of *umbratus*, are decidedly hypogæic. It does not make carton like the European *umbratus*. This is generally true also of our eastern *aphidicola*. I have, however, found a few colonies of this ant at Colebrook, Conn., and Ottawa, Ontario, nesting in dark brown carton nests in the centers of rotten logs.

The observations proving that the young queens of *subumbratus* establish their colonies with the aid of *sitkaënsis* and *neoniger* workers may now be transcribed from my note-book:

July 3 and 5. Four colonies of *subumbratus* were found under large stones. Two were of considerable size and the superficial chambers of the nests were full of black males and golden yellow females ready for the marriage flight.

July 8. The marriage flight of *subumbratus* must have occurred on July 6 or 7 as there were numerous deälated females running about among the stones on an open, sunny slope where many of the stones covered nests of *neoniger*. My son Ralph assisted me in carefully turning over the stones and examining these nests. In one area, about 200 feet in diameter, nearly every nest had from one to five deälated *subumbratus* queens running about in the large shallow superficial chambers. By shading the chambers, which were occupied by numerous *neoniger* workers and cocoons, the behavior of the yellow queens could be readily studied. They ran in and out of the chambers and galleries leading into the soil and, when accosted by the *neoniger* workers, made peculiar supplicatory movements with the antennæ, precisely like those of *Formica consocians* queens seeking adoption in nests of *F. incerta.* The *neoniger* workers, however, resented the intrusion and frequently seized the legs and antennæ of the queens, though they soon released their hold. The queens thus liberated often escaped from the nest and hid under stones near it or even in unfrequented nooks in the superficial chambers of the nest itself. On several occasions we saw a queen seize a *neoniger* worker, carry it out of the nest and release it uninjured. One queen was seen to snatch up a worker cocoon, carry it out of the nest and conceal it under an adjacent pebble. This is very suggestive of the behavior of the young *Formica sanguinea* queen that has entered a nest of *F. fusca*, but though it undeniably shows an interest on the part of the *subumbratus* queen in the *neoniger* brood, her method of colony formation is not that of *F. sanguinea*, for we soon discovered a depauperate *neoniger* colony which had undoubtedly adopted a *subumbratus* queen. The latter was moving to and fro very slowly and amicably in the midst of several *neoniger* workers and their cocoons in a small recess under a stone. The ants were watched for some time and behaved precisely like members of a single colony. That the queens are nevertheless occasionally treated much more severely by the *neoniger* workers, is apparent from the fact that we found a few recently killed and one partially eaten in the superficial chambers of some of the nests.

July 9. Visited another rocky slope and an adjoining pine forest about a mile east of Cloudcroft and two miles from the locality of yesterday's observations. Under the stones covering *neoniger* and *sitkaënsis* nests there were many deälated *subumbratus* queens eagerly seeking adoption. The following three colonies showed clearly that some of the queens had been or were being accepted:

1. A populous *sitkaënsis* colony under several large contiguous stones among the pines. The superficial galleries of the nest were filled with workers and worker, male and female cocoons nearly

ready to hatch. Under two of the stones a couple of *subumbratus* queens was found, each lurking quietly in a little cavity at the edge of a mass of cocoons nearly filling a large, shallow superficial chamber.

2. A similar but even larger *sitkaënsis* nest, also under a pile of stones, under three of which *subumbratus* queens were found. One of the queens was in a small cavity at the edge of a heap of cocoons while each of the others was resting on the very center of a collection of cocoons nearly as large as my palm. These queens had certainly been adopted and the picture presented was precisely like that of the recently adopted *Formica consocians* queens mounted on the cocoons and surrounded and fondled by the workers of *F. incerta* (Wheeler 1906). When the nest was disturbed the queens hurried into the galleries and disappeared in the soil. They had evidently become strongly negatively heliotactic, unlike queens that are still running about on the soil immediately after the marriage flight.

3. A fine *sitkaënsis* nest under a single large stone among the pines had an adopted *subumbratus* queen surrounded by dozens of workers in the center of a pile of worker and female cocoons nearly as large as my hand. She quickly slipped into a burrow and was only recovered by digging down into the soil to a depth of more than six inches. In this nest a few of the female *sitkaënsis* pupæ were naked, *i. e.*, not enclosed in cocoons.

Further search in the same locality brought to light two mixed colonies consisting of *subumbratus* and *sitkaënsis* workers. I failed to find the queens of the former species, which were probably present but hiding deep in the soil. The failure to find them is not surprising as one very rarely secures the mother queen of a fully developed colony of any of our species of *Lasius* without extensive and very careful excavation of the nest.

The foregoing observations show that the *subumbratus* queen has to acquire the brood odor of the host before she can be accepted. She therefore lurks very near the cocoons in a small earthen cavity and somewhat later, in the early stage of adoption, like *Formica consocians*, takes up a position on the brood. This renders her immune to attack by the host workers and gradually accustoms them to her presence. That adoption can be secured in very populous and flourishing colonies of *sitkaënsis* is shown by the observations of July 9. Nevertheless these observations throw no light on three interesting problems, which may be briefly considered:

1. The first problem relates to the elimination of the host queen, evidently a *conditio sine qua non* of successful colony formation by such temporary social parasites as *subumbratus*. The elimination is supposed to be effected in one of three ways: Either adoption succeeds only in host colonies that have already lost their rightful queen through death by accident or old age, or the queen is killed by her own workers after and because the young parasitic queen has secured their allegiance, or the latter assassinates the host queen. The first hypothesis seems to be supported by the above described adoption of a *subumbratus* queen in a depauperate colony of *neoniger*, although it is by no means certain that this colony was queenless. The large *sitkaënsis* colonies containing recently adopted *subumbratus* queens, however, would seem to support the second or third hypothesis. In regard to this problem in the European *umbratus*, Donisthorpe (1915) says: "No cases are known of the host queen and the parasite living together in a nest, so, unless a female can only be adopted by a queenless colony, it must sometimes happen that a female is accepted by a colony already possessing a queen of its own species. In such a case the intruder must either kill the rightful queen herself, as the female of (non-British) *Bothriomyrmex* kills the queen of her host *Tapinoma* or the workers of the host species must themselves assassinate their own queen, as do the workers of *Tetramorium cæspitum* when they have accepted a female *Anergates atratulus*." He adds, however, that "Crawley confined several queens of *umbrata* with queens of *nigra* and the latter were always killed by the former, which although a little the smaller, is stronger and possesses more powerful mandibles." It seems to me that the morphological peculiarities suggested by Donisthorpe, namely the much broader and larger head and stronger mandibles so characteristic of the female of all *umbratus* forms as compared with the same sex of *niger*, indicate very clearly that the parasite actually decapitates the host queen in much the same manner as *Bothriomyrmex decapitans* was seen by Santschi (1906) to decapitate the *Tapinoma erraticum* queen and the queen *Wheeleriella santschii*, the queen of *Monomorium solomonis* (Forel 1906).

2. The fact that one of the *sitkaënsis* colonies observed July 9 contained two fully adopted *subumbratus* queens and one on the verge of adoption suggests the question as to whether all three queens would survive as mothers of the compound colony or whether two of them would be subsequently eliminated. This question can, of course, be answered only by further investigation. But as the various species of the genus *Lasius* hitherto observed are decidedly haplometrotic it seems probable that at least in the majority of cases of adoption of several *subumbratus* queens by a *sitkaënsis* or *neoniger* colony, the number must be subsequently reduced to unity either by combats among the queens or by the regulatory intervention of the workers.

3. My field observations leave some doubt as to whether *sitkaënsis* or *neoniger* is the true, or normal host of *subumbratus.* Indirect evidence, however, points to the former variety, since the queens and workers of *subumbratus* are much more like the corresponding phases of *sitkaënsis* in size and coloration and since pure adult colonies of these forms prefer the same shady environment and have the same hypogæic habits. Reiff's Nova Scotia specimens of *subumbratus* queens from *sitkaënsis* nests may also be cited in this connection. *L. neoniger*, therefore, would be an unusual or perhaps recently acquired host, and the conditions would be comparable to those of the typical European *umbratus*, whose normal host is the typical *niger*, though it is occasionally parasitic, as Donisthorpe has shown (1915), on the subspecies *alienus*, the normal host of *mixtus.*

The rather large number of observed cases of adoption of *subumbratus* seems to indicate that the queen of this subspecies is specially favored as compared with the queens of some other temporary social parasites (*e. g. Formica rufa* and *truncicola*) by the possession of peculiar myrmecophilous characters (trichomes, exudate organs). I believe that the beautiful golden yellow color and pilosity of the *subumbratus* queen, which make it resemble the queens of *Formica consocians*, *ciliata*, *criniventris* and *oreas*, the smaller stature and the delicate odor may be designated as such characters. In this connection I may call attention to the queen of *Lasius crinitus*, long ago described by Frederick Smith from Cashmir, as being in all probability a temporary social parasite on *L. niger* or one of its varieties. I have recently seen a few queens of *crinitus* from Sikkim and was struck by their remarkable resemblance in color and pilosity to the queens of the Colorado *F. ciliata.* The source of the delicate odor of *subumbratus*, of the strong, lemon-verbena odor of our North American *Lasii* of the subgenus *Acanthomyops* and of the peculiar pungent, sweetish odor of the Eurasian *fuliginosus*, is worthy of further investigation. Meinert and Bönner believe that in *umbratus* and *fuliginosus* it comes from the salivary glands. Forel had previously traced it to the head as this portion of the body when crushed emitted a more violent aroma than the thorax and gaster. I have been under the impression that it might originate in the epinotal glands. Since it is so powerful and pervasive that it even saturates the walls of the nest a renewed and careful investigation may be required before its precise source in the body of the insect is known.

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Bussey Institution for Research in Applied Biology

XV

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XVI

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BY
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XIV

THE ANTS OF THE GALAPAGOS ISLANDS[1]

BY

William Morton Wheeler
Bussey Institution for Research in Applied Biology

Since the memorable voyage of the "Beagle" in 1835, more than a dozen biological expeditions have explored the Galapagos Islands, but none of the collectors, with a single exception, has bestowed more than the most casual attention on the ants, so that our knowledge of these insects and their distribution has been too fragmentary to have any weight in the famous controversy concerning the origin of the archipelago and its fauna. In 1877 Frederick Smith[2] described three species of *Camponotus* from Charles Island, two (*C. planus* and *macilentus*) taken by Darwin on the voyage of the "Beagle" and one (*C. senex*) taken by Cookson on the voyage

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 137.

[2] *Smith, Frederick.* Hymenoptera and Diptera in "Account of the Zoological Collection made during the visit of H. M. S. 'Peterel' to the Galapagos Islands." Proc. Zool. Soc. 1877, pp. 82-84.

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XIV

THE ANTS OF THE GALAPAGOS ISLANDS[1]

BY

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Since the memorable voyage of the "Beagle" in 1835, more than a dozen biological expeditions have explored the Galapagos Islands, but none of the collectors, with a single exception, has bestowed more than the most casual attention on the ants, so that our knowledge of these insects and their distribution has been too fragmentary to have any weight in the famous controversy concerning the origin of the archipelago and its fauna. In 1877 Frederick Smith[2] described three species of *Camponotus* from Charles Island, two (*C. planus* and *macilentus*) taken by Darwin on the voyage of the "Beagle" and one (*C. senex*) taken by Cookson on the voyage of the "Peterel" in 1875. Concerning the ants taken by the "Albatross" expedition of 1888, Howard[3] in 1890, makes only the following statement: "dark-colored species of the genus *Camponotus* was collected, one male from Albemarle Island, numerous males and two females from Charles Island. Of a light-colored species of the same genus seven males were taken on Charles Island and one on Albemarle Island." These were, without doubt, the sexual forms of Smith's *C. planus* and *macilentus.* In 1893 Emery[4] recorded the following species which he had received from Dr. George Baur, who made an expedition to the islands in 1891 in a sloop chartered in Guyaquil: *Solenopsis geminata* Fabr., *Tetramorium guineënse* Fabr., *Tapinoma melanocephalum* Fabr., *Odontomachus bauri* Emery, and *Camponotus peregrinus* Emery. All these forms were taken at Chatham Island, and all, except the first, were found on the ship, so that two of them, *Tetramorium guineënse* and *Tapinoma melanocephalum,* may have had their nests in the woodwork and may have come from Guyaquil. The *Camponotus peregrinus* can hardly be more than a variety of Smith's *planus.* Emery also mentions the receipt of five males of the genus *Camponotus* taken on one of the "Albatross" voyages: "One of them is black and comes from Albemarle and Charles islands, the other, of a testaceous color, with very pale legs, is represented by two specimens from Charles." These seem to be part of the two series mentioned by Howard, i. e., specimens of C. *planus* and *macilentus.* Since the publication of Emery's paper no additions have been made to the seven or eight forms recorded from the archipelago. I was much interested, therefore, to learn from Dr. F. X. Williams, that he had collected a number of ants while he was a member of the California Academy of Sciences Expedition (Voyage of the "Academy") in 1905 to 1906. Through the kindness of Dr. E. C. Van Dyke the specimens were loaned me for study. Dr. Williams also informed me that some ants had been taken by the Hopkins-Stanford Expedition to the Galapagos (Voyage of the "Julia E. Whalen") in 1898 to 1899, but correspondence with Prof. Vernon Kellogg revealed the fact that the specimens were no longer in the collections of Stanford University and that their whereabouts could not be ascertained. More recently the curators of the National Museum have generously loaned me the ants taken on some of the voyages of the "Albatross". Though in part poorly preserved, this material has been very useful in supplementing Dr. Williams's collection, which was made with great care and considerably increases our knowledge of the ant fauna of the archipelago.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 137.

[2] *Smith, Frederick.* Hymenoptera and Diptera in "Account of the Zoological Collection made during the visit of H. M. S. 'Peterel' to the Galapagos Islands." Proc. Zool. Soc. 1877, pp. 82-84.

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[3] *Howard, L. O.* Scientific Results of Explorations by the U. S. Fish Commission Steamer Albatross. V. Annotated Catalogue of the Insects Collected in 1887–1888. Proc. U. S. Nat. Mus. 12, 1889, pp. 185-207.

[4] *Emery, Carlo.* Notices sur Quelques Fourmis des Iles Galapagos. Ann. Soc. Ent. France, 63, 1893, pp. 89-92.

As shown in the accompanying table, the Galapagos ants which I have studied, comprise 36 different forms, representing 18 species, 10 genera and four of the five subfamilies of *Formicidæ*. Significantly the subfamily *Dorylinæ* is not represented. None of the genera is peculiar to the islands. Six

Names of Species, Subspecies and Varieties	Narborough	Albemarle	Duncan	Charles	Hood	Chatham	Barrington	Indefatigable	James	Tower	Bindloe	Abingdon
Cylindromyrmex striatus Mayr	...	...	...	...	...	...	...	X	...	...	...	...
Odontomachus bauri Emery	...	...	...	X	...	X	...	...	...	...	...	...
Pheidole williamsi Wheeler	...	...	...	...	...	...	...	X	...	...	...	...
Pheidole sp	...	X	...	...	...	...	...	...	...	...	...	...
Monomorium pharaonis L.	...	...	...	...	...	...	...	X	...	...	...	X
Solenopsis sævissima F. Smith	...	...	...	...	...	...	...	X	...	...	...	...
Solenopsis geminata Fabr	...	...	...	...	...	X	...	...	...	...	...	...
Solenopsis galapageia Wheeler	...	...	...	X	...	...	...	...	...	...	...	...
Solenopsis pacifica Wheeler	...	X	...	...	...	...	...	...	...	X	...	...
Solenopsis rubida Wheeler	...	...	...	...	X	...	...	...	...	...	...	...
Tetramorium guineense Fabr	...	X	...	...	...	X	...	...	...	...	...	...
Tetramorium simillimum F. Smith	...	...	...	X	...	...	...	...	...	...	...	...
Dorymyrmex albemarlensis Wheeler	...	X	...	...	...	...	...	...	...	...	...	...
Tapinoma melanocephalum Fabr	...	...	...	...	X	X	...	X	...	...	...	...
Prenolepis longicornis Latreille	...	...	...	X	...	...	...	...	...	...	...	...
Prenolepis itinerans Forel	...	...	...	...	...	X	...	X	...	...	...	...
Prenolepis nesiotis Wheeler	...	...	...	...	...	...	...	...	X	...	...	...
Camponotus senex F. Smith	...	...	...	X	...	...	...	...	...	...	...	...
Camponotus macilentus F. Smith	...	...	...	X	...	...	...	...	...	...	...	...
Camponotus jacobensis Wheeler	...	...	...	...	...	...	...	...	X	...	...	...
Camponotus albemarlensis Wheeler	...	X	...	...	...	...	...	...	...	...	...	...
Camponotus vulcanalis Wheeler	...	X	...	...	...	...	...	...	...	...	...	...
Camponotus duncanensis Wheeler	...	...	X	...	...	...	...	...	...	...	...	...
Camponotus narboroënsis Wheeler	X	...	...	...	...	...	...	...	...	...	...	...
Camponotus hoodensis Wheeler	...	...	...	...	X	...	...	...	...	...	...	...
Camponotus barringtonensis Wheeler	...	...	...	...	...	...	X	...	...	...	...	...
Camponotus bindloënsis Wheeler	...	...	...	...	...	...	...	...	...	...	X	...
Camponotus macilentus var	...	...	...	...	...	...	...	...	...	X	...	...
Camponotus planus F. Smith	...	...	...	X	...	...	...	...	...	...	...	...
Camponotus peregrinus Emery	...	...	...	...	...	X	...	...	...	...	...	...
Camponotus isabelensis Wheeler	...	X	...	...	...	...	...	...	...	...	...	...
Camponotus indefessus Wheeler	...	...	...	...	...	...	...	X	...	...	...	...
Camponotus santacruzensis Wheeler	...	...	...	...	...	...	...	X	...	...	...	...
Camponotus fidelis Wheeler	...	...	...	...	...	...	X	...	...	...	...	...
Camponotus fernandinensis Wheeler	X	...	...	...	...	...	...	...	...	...	...	...
Camponotus pinzonensis Wheeler	...	...	X	...	...	...	...	...	...	...	...	...
Number of forms on each island	2	7	2	7	3	6	2	8	2	2	1	1

of the species, *Monomorium pharaonis, Tetramorium guinëense* and *simillimum, Tapinoma melanocephalum, Prenolepis longicornis* and *P. vividula itinerans,* are well-known tropical "tramps", evidently introduced by commerce within recent times. Not improbably three others, *Solenopsis geminata, S. sævissima* and *Camponotus senex,* have been similarly introduced. Only nine species, therefore, would seem to be clearly indigenous to the islands. All of these are distinctly neotropical in their affinities and all but three, or possible four of them, namely *Pheidole williamsi, Pheidole* species, *Camponotus macilentus* and *C. planus,* are either well-known species, widely distributed in tropical and subtropical portions of America, or merely subspecies or varieties of such forms. Nevertheless, if we consider the distinct forms, no fewer than 26, or 72.2%, of the 36 are endemic, and these forms would undoubtedly rank as true species if the same estimate were applied to the subspecies and varieties of ants as is applied by the ornithologists and mammalogists to their taxonomic categories. This high percentage of endemicity agrees with what has been observed in other groups of organisms. Stewart[5] cites 615 species of plants from the archipelago, with 252, or 40.9%, endemic. Among the birds, according to Ridgway[6], 13.04% of the 46 genera are endemic; among the Arachnida, according to Banks[7], 31, or 57.4% of the 54 species are endemic; among the Orthoptera, according to McNeill[8] and Snodgrass[9], and among the Coleoptera cited by Linell[10], the percentage of endemicity is also very high, although the authors do not give precise percentages.

Many writers have noticed closer affinities between the Galapagos and Central American or West Indian species than between those of the Galapagos and the western coast of South America, but no such difference in affinities can be detected among the ants, because most of the neotropical species to which the Galapagos forms are most closely allied, are very widely distributed and because our knowledge of the ants of Ecuador, Peru and Chili is less complete than that of the ants of the West Indies, Central America and Brazil. I suspect that a similar dearth of knowledge of the western South American species of other groups may account for the high percentage of West Indian and Central American elements recorded by several authors as obtaining among the Galapagos organisms, as e. g., by Banks, who mentions only five of the 54 Galapagos spiders as being known from Western South America as compared with 14 from Central America, Colombia and the West Indies.

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[5] *Stewart, Alban.* A Botanical Survey of the Galapagos Islands. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906. II. Proc. Calif. Acad. Sci. (4) 1, 1911, pp. 7-288, 18 pls.

[6] *Ridgway, Robert.* Birds of the Galapagos Archipelago. Proc. U. S. Nat. Mus. 19, 1896, pp. 459-670, 2 pls.

[7] *Banks, Nathan.* Arachnida. Papers from the Hopkins-Stanford Galapagos Expedition 1898-1899, VII. Entomological Results (6). Proc. Wash. Acad. Sci. 4, 1902, pp. 49-86, 3 pls.

[8] *McNeill, Jerome.* Orthoptera. Papers from the Hopkins-Stanford Galapagos Expedition 1898-1899, IV. Entomological Results (4). Proc. Wash. Acad. Sci. 3, 1901, pp. 487-506, 10 figs.

[9] *Snodgrass, R. E.* Schistocerca, Sphingonotus and Halmenus. Papers from the Hopkins Stanford Galapagos Expedition. 1898-1899, VIII, Entomological Results (7). Proc. Wash. Acad. Sci. 4, 1902, pp. 411-455, 2 pls.

[10] *Linell, M. L.* On the Coleopterous Insects of the Galapagos Islands. Proc. U. S. Nat. Mus. 21, 1898, pp. 249-268.

Special interest attaches to the two species of *Camponotus, macilentus* and *planus,* as each of them is represented by distinct varieties on each of several of the larger islands. In fact, Albemarle Island possesses two varieties of *macilentus* and Indefatigable Island two of *planus.* The distribution of the various forms is shown in the following table:

	Islands.	
macilentus, typical....	Charles.......	*planus,* typical
	Chatham......	var. *peregrinus*
var. *narboroënsis*.....	Narborough...	var. *fernandinensis*
var. *albemarlensis*..... var. *vulcanalis*........	Albemarle.....	var. *isabelensis*
var. *duncanensis*......	Duncan.......	var. *pinzonensis*
	Indefatigable..	var. *indefessus* var. *santacruzensis*
var. *hoodensis*........	Hood.........	
var. *barringtonensis*...	Barrington....	var. *fidelis*
var. *jacobensis*.......	James........	
var. *bindloënsis*.......	Bindloe.......	
var................	Tower........	

Although a similar "harmonic" distribution has been observed in birds, reptiles and plants, the only group of invertebrates in which it has been recorded, is, to my knowledge, the Acridians. Snodgrass cites three species of

Schistocerca and two of *Sphingonotus,* each of which is represented by a recognizable subspecies or variety on each of several islands. The resemblance to the two species of *Camponotus* is further shown by the fact that *Schistocerca melanocera* is represented by two subspecies on Albemarle and that two forms of *Sphingonotus tetranesiotis* occur on Barrington and two on Indefatigable.

On the whole, the ant-fauna of the Galapagos is decidedly poor for islands lying on the equator and possessed of an abundant and varied flora. Dr. Williams informs me that even the colonies of the species which do occur on the larger islands are far from numerous and are found only after diligent search. Only one or two forms have been taken on most of the islands. Chatham has six, Charles and Albemarle each seven, and Indefatigable eight, but even these numbers indicate a very limited fauna. At first sight this might be regarded as evidence that the ant-fauna was accidentally introduced and had lingered on, undergoing slow varietal and subspecific modification in response to the different physical conditions on the various islands. In my opinion, however, no such conclusion can be legitimately advanced. The poverty of the fauna is more probably due to adverse conditions, as ants are not fond of volcanic soil, probably because it gives off deleterious gases in the process of decomposition, or does not afford proper nesting sites, as would be the case with the great stretches of hard lava said to occur on some of the Galapagos islands. The climatic conditions, moreover, are decidedly unfavorable, as the littoral zone of the islands up to 800 feet is very arid, while the more densely wooded portions, at higher levels, are cool and damp. I have pointed out in other publications that moisture coupled with a low temperature is very unfavorable to ant-life and have called attention to the meagre faunas of such regions as New Zealand, Great Britain and the Selkirk Mountains of British America in support of this contention.

The bearing of my study of the Galapagos ants on the two great rival hypotheses that have been advanced to account for the origin of the islands and of their biota, is indecisive. A study of the literature shows that the problem is still far from solution and that probably as much evidence can be adduced in support of the subsidence or "continental" as for the emergence or "oceanic" origin of the archipelago. So evenly divided are the authorities that 19, namely, Darwin, Wallace, Hooker, A. Agassiz, Salvin, Griesebach, Engler, Moritz Wagner, Peschel, Wolf, Dall, Stewart, Stearns, Snodgrass, Heller, Robinson, Williams, McNeill and Matthew, have expressed themselves in favor of the "oceanic" hypothesis, while an equal number, namely, H. Milnes Edwards, Murray, Baur, Hemsley, Ridgway, Robinson and Greenman, Boetger, von Ihering, Handlirsch, Scharff, Ortmann, Ratzel, Günther, Sarasin, Gadow, Arldt, Barbour, and Van Denburgh, have expressed themselves as favoring a "continental" origin of the archipelago. Eleven other workers who have studied material from the islands, namely Banks, Coquillet, Currie, Heidemann, Kellogg, Gifford, Linell, Howard, Garman, Rothschild and Hartert, have not committed themselves to either hypothesis. Some of the authors who take sides in the controversy are evidently influenced by the fancied facilities afforded by their special groups of organisms for transportation by winds or currents from the western coast of South or Central America. The botanists find it easy to suppose that seeds and the spores of ferns have thus found their way to the islands, while herpetologists balk at postulating such means of transportation for the huge land tortoises which have been so carefully studied by Baur and by Van Denburgh. At least one of the authors, Robinson, has changed his views in the course of his studies. In his first paper on the flora, written in collaboration with Greenman[11], he favored the Murray-Baur hypothesis of a continental origin of the islands, but in a more voluminous work[12], based on additional collections, he returns to the older Darwin-Wallace hypothesis. Some authors, like Stearns[13], Dall[14] and Stewart, make much of the "flotsam and jetsom" origin of the Galapagos fauna and flora, whereas others like Scharff, very properly point to the lack of positive observations on any such method of transportation. The unbiassed worker can only conclude from what has been written on the subject, and, notwithstanding the many excellent monographs that have been produced on various portions of the fauna and flora, that we need a still more intensive and exhaustive exploration of the islands and above all a much better acquaintance with their geology than we now possess, before he can definitely accept either of the hypotheses.

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[11] *Robinson, B. L., and Greenman, J. M.* On the Flora of the Galapagos Islands as shown by the collections of Dr. G. Baur. Amer. Journ. Sci., 50, 1895, pp. 135-176.

[12] *Robinson, B. L.* Flora of the Galapagos Islands. Papers from the Hopkins Stanford Expedition to the Galapagos Islands. Proc. Amer. Acad. Arts and Sci. 38, 1902, pp. 77-269, 3 pls.

[13] *Stearns, R. E. C.* Report on the Mollusk Fauna of the Galapagos Islands, with Descriptions of New Species. Proc. U. S. Nat. Mus. 16, 1893, pp. 353-450.

[14] *Dall, W. H.* Insular Landshell Faunas, Especially as Illustrated by the Data Obtained by Dr. G. Baur in the Galapagos Islands. Proc. Acad. Nat. Sci., Phila., 1896, pp. 395-459, 3 pls.

Family FORMICIDÆ.

Subfamily PONERINÆ.

1. **Cylindromyrmex striatus** Mayr.

Cylindromyrmex striatus Mayr, Verh. zool. bot. Ges. Wien 20, 1870, p. 697 ♀; *ibid.*, 37, 1887, p. 546 ♀ (*nec* ☿, *nec* ♂); Emery, Ann. Soc. Ent. Belg. 45, 1901, p. 53; Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 15.

Holcoponera whymperi Cameron, in Whymper, Travels Andes Equator, Suppl. Append. 1891, p. 92, fig. ☿.

Cylindromyrmex whymperi Forel, Ann. Soc. Ent. Belg. 36, 1892, p. (2).

A large ocellate and a small nonocellate worker taken by F. X. Williams at Academy Bay, Indefatigable Island, agree perfectly with Cameron's figure of *Holcoponera whymperi* from Guyaquil, Ecuador. His specimen was taken indoors, which indicates that the species may occur about houses, unlike other Ponerinæ, and suggests that it may have been recently introduced into the Galapagos by vessels from the Ecuadorian or Peruvian Coast.

2. **Odontomachus hæmatoda bauri** Emery.

Odontomachus bauri Emery, Ann. Soc. Ent. France, 60, 1891, p. 591 ☿; *ibid.*, 63, 1893, p. 476, fig.

Odontomachus hæmatoda bauri Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 115.

Worker. Length 9—11 mm.

Differing from the worker of the typical form in having the head proportionally narrower behind, slightly narrower mandibles, with longer preapical tooth, the smooth, shining portion of the occiput extending somewhat further forward and that of the sides of the head further dorsally. The longitudinal striæ of the pronotum and transverse striæ of the epinotum are somewhat coarser and the anterior surface of the petiole is rather coarsely, transversely striate. The pilosity, pubescence and color are much as in the typical *hœmatoda,* but the body has a somewhat bronzy lustre and the antennæ and legs are darker.

Female. Length 10—11 mm.

Very similar to the worker and differing from the female of the typical *hœmatoda* in the same characters. The wings measure only 7 mm. or somewhat less, however, whereas those of the typical *hœmatoda* measure at least 8 mm.

Male. Length 6 mm.

Closely resembling the male of the typical *hœmatoda,* except in color. The head, thorax, legs and antennæ are whitish yellow, with the epinotum, petiole and dorsal surface of the gaster dark brown, the venter brownish yellow. The mesonotum has a dark brown longitudinal spot on each side and a slightly paler median spot of the same color just behind its anterior border. Wings whitish, with pale brown stigma.

This form, which is extremely close to the typical *hœmatoda,* so widely distributed in the tropics of both hemispheres, was described by Emery from a single worker taken by Dr. G. Baur on Chatham Island. I have redescribed it from a number of workers and females and a single male taken by Dr. F. X. Williams on the same island and at Cormorant Bay, Charles Island. The specimens were nesting under stones from sea-level to an altitude of 1100 feet.

Subfamily MYRMICINÆ.

3. **Pheidole williamsi,** new species.

Soldier. Length 2.3—2.6 mm.

Head small, subrectangular, scarcely longer than broad and scarcely broader behind than in front, with rounded posterior and anterior corners, feebly excised posterior border, nearly straight sides and the eyes of moderate size and situated in front of the middle. Mandibles rather convex, with two large apical and several minute and rather irregular basal teeth. Clypeus short, flat, with the anterior border deeply notched in the middle. Frontal area triangular, not impressed; frontal carinæ short, subparallel in front, slightly diverging behind; median dorsal groove shallow, running only from the occipital excision to the middle of the head. Antennæ slender, scapes curved but not flattened at the base, only slightly thickened at their tips, which nearly reach the posterior corners of the head; all the funicular joints distinctly longer than broad; club slender, shorter than the remainder of the funiculus. Thorax rather small; pronotum very convex, broadest through the humeri, which are rounded; mesonotum in profile sloping, with a strong, short, transverse convexity in the middle; epinotum long, its base straight in profile, fully 1½ times as long as the declivity, which is concave; spines short, slender, longer than broad at their bases, shorter than their distance apart at the base, directed backward and upward and very slightly outward. Petiole narrower in front than behind through the node, which in profile has a long, concave anterior and short, feebly concave posterior slope and rather acute summit; seen from behind the superior border of the node is deeply notched in the middle. Postpetiole scarcely a fourth again as broad as the petiole, broader than long, transversely elliptical, with rounded sides and dorsal surface. Gaster as large as the head, of the usual shape. Legs rather slender, femora only feebly incrassated in the middle.

Shining; mandibles coarsely punctate; sides of clypeus and anterior half of the head longitudinally rugulose; remainder of head smooth and shining, with minute, scattered, piligerous punctures. Pronotum transversely rugulose; mesonotum, epinotum, petiole and postpetiole subopaque, finely and densely punctate; gaster and legs shining, with sparse piligerous punctures.

Whole body, including the legs and antennæ, covered with moderately abundant and rather coarse yellow hairs, varying in length but longer and more erect on the body, more reclinate on the scapes and legs.

Brownish yellow; legs paler; posterior two-thirds of head somewhat darker and more reddish, borders of mandibles blackish, anterior clypeal border deep red.

Worker. Length 1.5 mm.

Head elliptical, longer than broad, rounded and entire behind, with the eyes just in front of the middle of the sides. Mandibles rather narrow, with about six teeth. Clypeus convex in the middle, its anterior border feebly but distinctly notched in the middle. Frontal carinæ very short. Antennæ much as in the soldier, scapes reaching nearly one-third their length beyond the posterior border of the head. Thorax like that of the soldier, but the pronotum much less convex and narrower, the mesonotum much less convex in profile and the spines of the epinotum reduced to minute, slender teeth. Petiole slender, its node low, with entire superior border; postpetiole small, subglobular.

Smooth and shining; mandibles sparsely punctate; cheeks longitudinally rugulose; meso- and epinotum, petiole and postpetiole subopaque, finely and indistinctly punctate.

Pilosity shorter and much less conspicuous than in the soldier, appressed on the scapes and legs.

Yellow; dorsal surface of head and gaster brownish; mandibular teeth blackish.

Female. Length 5—5.5 mm.

Head resembling that of the soldier, but a little narrower in front than behind, with nearly straight posterior border. Thorax large, as broad as the head, mesonotum nearly circular, flattened, as is also the scutellum. Epinotum with the declivity sloping, distinctly longer than the base, the spines stout, scarcely longer than broad at their insertions. Petiolar node less deeply excised above and postpetiole more transverse than in the soldier. Gaster large, of the usual shape. Wings measuring about 6 mm.

Mandibles and clypeus rather shining, the former striato-punctate, the latter longitudinally rugose. Head subopaque, longitudinally rugose, the rugæ extending to the occiput where they are mingled with coarse longitudinal punctures. Pronotum, pleuræ, epinotum, petiole and postpetiole opaque and densely punctate. Epinotum coarsely transverely rugose between the spines, the postpetiole longitudinally rugose.

Mesonotum, paraptera and scutellum smooth and shining, with coarse, sparse, piligerous punctures. Gaster shining, finely shagreened and very sparsely and finely punctuate.

Pilosity much as in the soldier.

Brownish yellow; pleuræ, epinotum, nodes, posterior portion of each gastric segment, scutellum, a large spot on the middle of the mesonotum and the mandibular teeth, brown. Wings yellowish hyaline, with pale yellow veins and scarcely darker stigma.

Male. Length 4—4.5 mm.

Head through the eyes slightly broader than long, flattened above, produced behind in the ocellar region, with very short cheeks and large eyes. Mandibles minute, bidentate. Clypeus carinate, convex behind. Antennal scapes as long as the two basal funicular joints together. Thorax broad and short, flattened above; epinotum sloping, rounded, unarmed, without distinct base and declivity. Petiole and postpetiole like those of the soldier, the node of the former being lower, more rounded and entire.

Mandibles and clypeus shining. Head above more opaque, especially on the sides, rugulose. Thorax, postpetiole and gaster shining and sparsely punctate; pleuræ and epinotum subopaque, the latter longitudinally rugulose.

Pilosity as in the female, but shorter and less abundant.

Mandibles, clypeus, antennæ and legs pale yellow; remainder of body brown, the head darker behind, the sutures of the thorax broadly pale yellow. Wings colored as in the female.

Described from several specimens of each of the phases taken on Indefatigable Island by Dr. F. X. Williams.

Cotypes, 12 specimens, No. 444, Museum California Academy of Sciences.

The soldier of this species resembles that of *Ph. arhuaca* Forel of Colombia in size and coloration, but is very distinct in the longer antennæ, notched clypeus, different shape of the mesonotum and in the sculpture of the dorsal surface of the head. It is even more closely related to *Ph. alfaroi* Emery of Costa Rica, but the soldier of this species is larger (4.5 mm.) and differs considerably from *williamsi* in the structure of the thorax, petiole, epinotal spines, etc.

4. **Pheidole,** species.

Among the "Albatross" material of the National Museum there are several poorly preserved or defective females and males belonging to a small *Pheidole* of the *flavens* group from Albemarle Island. One of these, a female, of which only the head and thorax remain, is labelled *"Pheidole galapagensis* Ashmead, type, No. 5515". Nothing can be done with this material at the present time, since soldiers are lacking and since our knowledge of the females and males of the known species of the large and exasperating group of *Pheidole* to which it belongs is very fragmentary.

5. **Monomorium pharaonis** (L.)

Formica pharaonis Linné, Syst. Nat. Ed. 10, 1, 1758, p. 580 ☿.

Formica antiguensis Fabricius, Ent. Syst. 2, 1793, p. 357.

Myrmica domestica Shuckard, Mag. Nat. Hist. (2), 1838, p. 626 ☿ ♀.

Myrmica unifasciata Bostock, Trans. Ent. Soc. London, 2, 1839. Proc. LI-LII.

Atta minuta Jerdon, Madras Journ. Litt. and Sci. 17, 1851, p. 105.

Myrmica (*Monomorium*) *fragilis* F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 124 ☿.

Myrmica (*Monomorium*) *contigua* F. Smith, *Ibid.*, p. 125 ♀.

Myrmica (*Monomorium*) *molesta* F. Smith (*nec* Say), *Ibid.*, p. 122 ☿ ♀ ♂.

Monomorium pharaonis Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 752.

Myrmica pharaonis Roger, Berl. Ent. Zeitschr. 6, 1862, p. 294 ♀ ♂.

Diplorhoptrum domesticum Gaskell, Ent. Month. Mag. 13, 1877, p. 254.

Two workers from Indefatigable Island and four workers and three deälated females from Abingdon Island (F. X. Williams). This common house and ship ant has evidently been imported into the islands by commerce.

6. **Solenopsis sævissima** F. Smith.

Myrmica sævissima F. Smith, Trans. Ent. Soc. London (2) 3, 1855, p. 166 ☿. Pl. 13, Fig. 18; Bates, Natural. Riv. Amazon, 1863; Trans. Ent. Soc. London (3) 1, 1864, Proc. 214.

Solenopsis geminata Fabricius race *pylades* Forel, Ann. Soc. Ent. Belg. 48, 1904, p. 172 ♀.

Solenopsis pylades Forel, Deutsch. Ent. Zeitschr. 1909, p. 268 ☿ ♀.

Solenopsis sævissima Wheeler, Bull. Amer. Mus. Nat. Hist., 34, 1915, p. 395; Psyche, 23, 1916, p. 142.

A single worker from Indefatigable Island (F. X. Williams), unmistakably belongs to this species, though it is somewhat damaged. The hairs on the body, however, are more abundant, more flexuous and paler than in my specimens from Argentina, Brazil and British Guiana, but in this respect the Galapagos specimen agrees with a series taken by Silvestri at Talca, Chili. *S. sævissima,* as the foregoing localities show, is very widely distributed in tropical America. It was originally described from Brazil.

7. **Solenopsis geminata** (Fabricius).

Emery records this species as having been taken by Baur on Chatham Island. Perhaps the specimens belong to the following variety. I have omitted the long and tangled synonymy of *S. geminata,* much of which can be found in Dalla Torre's Catalogus Hymenopterorum 7, 1893, p. 76.

8. **Solenopsis geminata galapageia,** new variety.

Several workers and females taken by Dr. Williams on Charles Island "under stones near top of crater" average smaller than the corresponding phases of the typical *geminata.* The females are only 6—6.5 mm., the largest workers only 4—4.5 mm., whereas the females of the typical *geminata* measure 7—8 mm., the largest workers 6—6.5 mm. In color the Galapagos specimens are much like the typical Central and South American specimens, being somewhat paler than the var. *nigra* Forel and darker than the var. *diabola* Wheeler.

Cotypes, 6 specimens, No. 445, Museum California Academy of Sciences, and 8 specimens in author's collection.

9. **Solenopsis globularia pacifica**, new subspecies.

Worker. Eyes slightly smaller, pilosity longer and coarser, postpetiole and gaster distinctly more voluminous as compared with the petiole than in the typical form, represented in my collection by specimens taken by W. M. Mann in Natal, Brazil.

Male. Eyes more convex and perhaps a little larger, head narrower behind, mandibles smaller, epinotum more sloping, more rounded and less angular than in the typical *globularia*. The color is also different, the body being dark brown, the antennæ and legs whitish or pale yellow, whereas in the typical form the body is black and the appendages brown.

Thirteen workers and four males from Albemarle and Tower Islands ("Albatross 1899", U. S. Nat. Mus.). Albemarle should be regarded as the type locality.

Cotypes, 2 specimens, No. 446, from Albemarle Island, Museum California Academy of Sciences, and 6 specimens from Albemarle in author's collection.

10. **Solenopsis globularia pacifica rubida**, new variety.

Worker. Length 1.8 mm.

Differing from the other forms of the species in color, the body being red, with the mandibles, antennæ and legs yellow and the first gastric segment, except its anterior and posterior borders, black. The postpetiole is globular, but little broader than long.

Described from a single specimen taken by Dr. Williams on Hood Island "under a stone".

Holotype, No. 447, Museum California Academy of Sciences.

11. Tetramorium guineënse (Fabricius)

Formica guineënsis Fabricius, Ene. Syst., 2, 1793, p. 357 ☿.

Myrmica bicarinata Nylander, Acta. Soc. Sc. Fennic. 2, 1846, p. 1061 ☿ ♀.

Myrmica cariniceps Guérin, Rev. Mag. Zool. (2) 4, 1852, p. 79 ☿.

Myrmica kollari Mayr. Verh. zool. bot. Ver. Wien, 5, 1855, p. 425 ☿ ♀ ♂.

Tetramorium cariniceps Roger, Berlin, Ent. Zeitschr. 5, 1861, p. 171.

Myrmica reticulata F. Smith, Trans. Ent. Soc. London (3) 1, 1862, p. 33 ☿.

Tetramorium kollari White, Ants and Their Ways, 1883, p. 262 ☿.

Tetramorium guineënse Mayr, Verh. Zool. bot. Ges. Wien, 20, 1870, p. 972 ☿.

A single worker of this undoubtedly introduced tropicopolitan ant from South Albemarle (F. X. Williams) and 14 workers taken by the "Albatross" (U. S. Nat. Mus.) but bearing only the label "Galapagos Islands, 1899." Emery records the species as taken also on the boat at Chatham Island by Dr. G. Baur.

12. Tetramorium (Tetrogmus) simillimum (F. Smith)

Myrmica simillima F. Smith, List Brit. Anim. Brit. Mus. 6, 1851, p. 118 ☿.

Tetrogmus caldarius Roger, Berl. Ent. Zeitschr. 1, 1857, p. 12 ☿ ♀.

Myrmica (Leptothorax) simillima F. Smith, Cat. Brit. Fossor. Hymen., 1858, p. 31 ☿.

Myrmica caldaria Meinert, Naturv. Aft. Dansk. Vid. Selsk. (5) 5, 1860, p. 334 ☿ ♀ ♂.

Tetramorium simillimum Mayr, Europ. Formicid. 1861, p. 61 ☿.

A single worker taken by Dr. Williams on Charles Island, "under stones near top of crater." This species, like *T. guineënse,* is a tropicopolitan "tramp" of Old World origin. It is not infrequently found in hot-houses in temperate regions.

Subfamily DOLICHODERINÆ.

13. **Dorymyrmex pyramicus albemarlensis, new variety**

Worker. Length 2.3—2.5 mm.

Resembling the var. *bicolor* Wheeler, but smaller and the head somewhat narrower and longer, with nearly straight sides and the epinotal cone smaller. The eyes are small, just in front of the middle of the head. Sculpture, pilosity and color as in *bicolor*, the head, thorax and antennal scapes a little more sordid red, the funiculi, petiole, gaster and legs dark brown or blackish.

Five workers from South Albemarle (F. X. Williams) and 19 workers from the same island taken by the "Albatross" in 1899 (U. S. Nat. Mus.). This form is very closely related to one of which several specimens were sent me by Mr. C. H. Tyler Townsend from Piura, Peru. The Peru form may be designated as **peruvianus,** new variety. It measures 2.5–3 mm. and is therefore as large as var. *bicolor*. The head is shaped like that of *albemarlensis* but the epinotal cone is as large as in *bicolor* and rather blunt. The color, however, is different, the head, thorax, petiole, legs, scapes, bases of funiculi and extreme base of the first gastric segment being clear, bright yellow, the remainder of the gaster black. The head is very smooth and shining, the remainder of the body a little more opaque, the pubescence is finer and less conspicuous.

Cotypes, 2 specimens, No. 448, Museum California Academy of Sciences; also 2 paratypes from Albatross collection of 1899.

14. **Tapinoma melanocephalum** Fabricius

Formica melanocephala Fabricius, Ent. Syst. 2, 1793, p. 353 ☿.

Lasius melanocephalus Fabricius, Syst, Piez. 1804, p. 417.

Myrmica melanocephala Lepeletier, Hist. Nat. Insect. Hymen. 1, 1836, p. 185.

Formica nana Jerdon, Madras Journ. Litt. and Sci. 17, 1851, p. 215 ☿.

Myrmica pellucida F. Smith, Journ. Proc. Linn. Soc. Zool. 2, 1857, p. 71 ☿.

Myrmica (Monomorium) pellucida F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 124 ☿.

Formica familiaris F. Smith, Journ. Proc. Linn. Soc. Zool. 4, 1860, Suppl. p. 96 ☿.

Tapinoma melanocephalum Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 651.

Two worker specimens, one from the east side of Indefatigable Island, the other from Hood Island (F. X. Williams). This species is also recorded by Emery as having been taken on the boat at Chatham Island by Dr. G. Baur. Like the two species of *Tetramorium, Tapinoma melanocephalum* has been disseminated throughout the neotropical region from its original home in the Indomalayan region and has become a pest about houses and shops.

Subfamily CAMPONOTINÆ.

15. **Prenolepis (Nylanderia) longicornis** (Latreille)

Formica longicornis Latreille, Hist. Nat. Fourmis. 1802, p. 113 ☿.

Formica vagans Jerdon, Madras Journ. Litt. Sc. 17, 1851, p. 124 ☿ ♀.

Formica (Tapinoma) gracilescens Nylander, Ann. Sc. Nat. Zool. (4) 5, 1856, p. 73 ☿.

Tapinoma gracilescens F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 56.

Prenolepis gracilescens Mayr, Verh. zool. bot. Ges. Wien, 12, 1862, p. 698.

Prenolepis longicornis Roger, Verz. d. Formicid. 1863, p. 10.

Five workers from Cormorant Bay, Charles Island (F. X. Williams). This species is of Indomalayan origin like *Tapinoma melanocephalum* and has also become a household pest throughout the tropics and even in some cities in temperate regions. It is known to nest on ships and has brought its Old World myrmecophiles, a beetle, *Coluocera maderæ,* and a cricket, *Myrmecophila prenolepidis,* to America. Both of these insects were recently taken by Dr. W. M. Mann on the island of Haiti in nests of *P. longicornis.*

16. **Prenolepis (Nylanderia) vividula guatemalensis itinerans** Forel.

Prenolepis guatemalensis Forel var. *itinerans* Forel, Mitth. Naturh. Mus. Hamburg 18, 2. Beih. 1901, p. 81 ☿.

A single worker from Indefatigable Island and two deälated females from Cormorant Bay, Charles Island, taken in October, 1905, by F. X. Williams. Two workers, a male and four females, taken by the "Albatross" in 1899 (U. S. Nat. Mus.), but labelled only "Galapagos Islands," also belong to this variety, which was originally described from specimens introduced into Hamburg with plants from Brazil. I have compared the Galapagos specimen with cotypes given me by Prof. Forel.

17. **Prenolepis (Nylanderia) fulva nesiotis, new** subspecies.

Worker. Length 1.6—2 mm.

Differing from all the known forms of *fulva* in its small size and in the shape of the thorax, the mesonotum being somewhat more convex and descending more abruptly behind to the constriction. On the other hand, the epinotum is distinctly less convex, its base about half as long as the declivity, which is straight in profile. Scapes extending two-fifths their length beyond the posterior border of the head. Sculpture and pubescence much as in the typical *fulva,* but the pilosity is less abundant and somewhat finer, especially on the legs and scapes. Dark brown, mandibles, clypeus, front of head, scapes, first funicular joint, legs and mesonotum paler and more reddish.

Female (deälated). Length 4 mm.

Differing from the worker in pilosity, the stiff erect hairs being absent on the scapes and legs, though conspicuous on the upper surface of the head, thorax and gaster. The pubescence is longer and denser and the whole body therefore slightly less shining. The thorax seen from above and excluding the epinotum is circular and broader than the head, which is small, subrectangular, fully as broad as long and a little broader behind than in front. The scapes extend about half their length beyond the posterior corners of the head.

Male. Length 1.5—1.75 mm.

Somewhat paler and more uniformly reddish brown than the worker and female. Wings gray, with brown veins and stigma. Pilosity much as in the female, but the pubescence sparser and shorter than in the worker so that the body appears shining. Antennal scapes reaching about half their length beyond the posterior corners of the head. Genitalia much as in the typical *fulva.*

Described from several workers and males taken by Dr. Williams on James Island (2000 ft., under stones) and two females from Chatham Island (low altitude, under stones).

Cotypes, 8 specimens, No. 449, Museum California Academy of Sciences.

At first sight I took these ants to represent a form of *P. vividula* or a small form of *P. bourbonica,* like the var. *hawaiiensis* Forel, but the genital appendages proved on dissection to conform to the *fulva* type. The new subspecies is, however, smaller than any of the recorded forms (subspecies *pubens* Forel, subspecies *biolleyi* Forel, var. *longiscapa* Forel). The mesonotum in profile is much like that of *biolleyi,* but the epinotum is distinctly less convex.

In the colony taken on James Island, Dr. Williams found six specimens of a myrmecophilous Bethylid, which proved to be a new species of *Scleroderma.* This is described by Prof. C. T. Brues in an accompanying paper.

18. **Camponotus (Myrmobrachys) senex** (F. Smith).

Formica senex F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 47 ☿ ♀.

Camponotus senex Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 676; *ibid., 27,* 1877, p. 867, ☿ ♀ ♂; F. Smith, Proc. Zool. Soc. London 1877, p. 83.

Camponotus (*Myrmobrachys*) *senex* Forel, Rev. Suisse Zool. 22, 1914, p. 271.

Frederick Smith cites this well known neotropical species as having been taken on Charles Island by W. E. Cookson, commander of the "Peterel" on her voyage to the Galapagos in 1875. As no specimens of it are among the collections of the California Academy or the "Albatross" Expeditions, and as Smith was notoriously careless in making identifications even of his own species, its inclusion among the Galapagos ant fauna must be regarded as doubtful.

19. Camponotus (Myrmamblys) macilentus F. Smith.

Camponotus macilentus F. Smith, Proc. Zool. Soc. London, 1877, p. 83 ☿.

Smith described this species very briefly from worker specimens taken by Charles Darwin on Charles Island as follows: "*Worker.* Length, 2¼ lines. Pale ferruginous, with the legs pale testaceous, smooth and shining, and having a few scattered pale hairs. The head wider than the thorax, oblong, with the eyes large, ovate and black; the vertex slightly emarginate behind. Thorax compressed and much narrowed behind, convex above. Abdomen wider than the head, and oblong ovate. The scale of the petiole wedge-shaped and rounded above."

I have not seen specimens of this ant from Charles Island, but I have before me a number of specimens from many of the other islands and these specimens differ varietally according to their localities. Hence I am compelled to describe in detail the form from James Island, which is represented by the most complete series, as if it were the specific type and to compare with it the several other varieties. I assume that when the type from Charles Island is again collected, it will prove to differ at least as much from the other forms as these differ from each other. From the fact that Smith says nothing about the color of the abdomen of his specimen, I infer that it was probably without dark markings like the variety which I call *hoodensis*.

The following varieties show that *C. macilentus,* which has remained unknown to myrmecologists since it was described by Smith and has been placed by Forel among the *Camponoti incertæ sedis,* is a true *Myrmamblys,* rather closely related to *C. claviscapus* Forel, a species widely distributed in Central America, Brazil and the West Indies. *C. claviscapus,* however, is smaller and the worker major has a much more sharply rectangular head, with flattened and strongly and abruptly incrassated tips to the antennal scapes. This species nests in hollow twigs, but Dr. Williams on the label to the specimens of *macilentus* var. *hoodensis* mentions their occurrence "under stones".

20. **Camponotus (Myrmamblys) macilentus jacobensis,** new variety.

Worker major. Length 7.5—8 mm.

Head about one-quarter longer than broad, subrectangular, a little narrower in front than behind, with nearly straight sides posteriorly and occipital border and the cheeks rather convex though feebly impressed near the insertions of the mandibles. Upper surface of head convex; eyes large, flat, elliptical, their anterior orbits distinctly behind the middle of the head, two small ocellus-like pits on the vertex and a sharply defined frontal groove extending half the distance from the clypeus to the posterior margin. Clypeus suboblong, one-quarter longer than broad, nearly as broad behind as in front, carinate on its posterior half, with a deep pit at the suture on each side in front; its anterior border feebly rounded, not produced, distinctly crenulate. Frontal area minute and indistinct, transverse, rather deeply impressed. Frontal carinæ more than half as long as the head behind the clypeus, strongly diverging, more than twice as far apart at their posterior as at their anterior ends. Mandibles rather small, very convex, 5-toothed. Antennæ slender, scapes curved, slightly flattened at the base, their tips gradually thickened, surpassing by a distance equal to their greatest diameter the posterior corners of the head. Thorax rather short, narrower than the head, laterally compressed behind, arcuate above in profile with sharply impressed promesonotal and mesoëpinotal sutures; pro- and mesonotum slightly flattened above, epinotum high, in profile with subequal base and declivity, the former convex, the latter abrupt, forming a rounded right angle with it, straight above and very feebly concave below. Petiole small, nearly as broad as the posterior end of the epinotum, but only about half as high as the epinotal convexity, its node broadest above, evenly rounded and entire, with moderately acute margin; in profile it is inclined forward somewhat and has a convex anterior and flat posterior surface. Gaster rather long and narrow, with subparallel sides and the four segments of subequal length. Legs moderately long, the fore femora somewhat enlarged.

Smooth and shining, very finely and delicately shagreened; mandibles, clypeus and head slightly subopaque, covered with minute, shallow punctures, which are densest on the mandibles. Pro- and mesonotum with a few elongate, shallow foveolæ above.

Hairs pale yellow, erect, very sparse and rather short, confined to the dorsal surface, the venter and the tips of the scapes and femora. Pubescence pale, short and dilute, distinct only on the legs and antennæ.

Brownish yellow, legs pale yellow; mandibles, scapes and tarsi reddish, the mandibles with narrow blackish borders. Front, vertex and sides of meso- and epinotum clouded with brown and each gastric segment with a broad dark brown band across its posterior surface. This band expands in the middle to form a rather broad streak which reaches to the anterior border of the segment.

Worker minor. Length 4.5—5.5 mm.

Resembling the worker major, but the posterior corners of the head are much more rounded, the clypeus is trapezoidal and scarcely longer than broad and the antennal scapes extend about one-quarter their length beyond the posterior corners of the head. The puncturation of the head is less distinct than in the worker major so that this region is more shining. In other respects the sculpture, pilosity and color are very similar.

Female. Length 8—8.5 mm.

Closely resembling the worker major but the head is smaller and more narrowed in front, with the antennal scapes extending about one-sixth their length beyond its posterior corners, the petiolar node is thicker and much blunter, with its upper margin more transverse and very feebly impressed in the middle. The thorax is rather long and narrow, though as broad as the head, the mesonotum as long as broad. Wings long (nearly 9 mm.).

Sculpture, pilosity and coloration very much as in the major worker. Wings distinctly yellowish, with pale brown veins and pterostigma.

Male. Length 6 mm.

Head through the very large and convex eyes as broad as long, rounded behind, with straight, parallel cheeks. Clypeus subrectangular, as broad as long, carinate, with rounded anterior border. Mandibles indistinctly tridentate. Antennæ very slender, the scapes reaching about one-half their length beyond the posterior border of the head. Mesonotum nearly circular, as broad as the head through the eyes. Epinotum convex and rounded, without distinct base and declivity. Node very thick, blunt and low, its border transverse and very feebly impressed in the middle. Gaster and legs slender.

Sculpture and pilosity much as in the minor worker.

Brownish yellow, legs scarcely paler; ocellar region dark brown, gastric segments pale brown, except at their anterior and posterior edges. Wings colored as in the female.

Described from 10 major workers, seven minor workers, seven females and a single male taken by Dr. F. X. Williams from a single colony on James Island during August, 1906.

Cotypes, 12 specimens, No. 450, Museum California Academy of Sciences, and 12 specimens in author's collection.

21. **Camponotus (Myrmamblys) macilentus barringtonensis,** new variety.

Worker minor. Length 4—5.5 mm.

Differing from the var. *jacobensis* in its distinctly paler and more ivory-yellow color, the brown clouds on the vertex and thorax being paler and less sharply defined or more diffuse, so that in some specimens the whole meso- and epinotum is pale brownish. The bands on the gaster are narrower, their mid-dorsal expansion shorter and the color of these markings, though paler than in *jacobensis,* is nevertheless darker than those on the head and thorax. The knees are distinctly brownish.

Female. Length 8—8.5 mm.

Colored very much like the minor worker, but the bands on the gaster are broad and sharply defined and their mid-dorsal expansions are broken into spots.

Twenty-one minor workers and eight females from a single colony taken by Dr. Williams on Barrington Island during October, 1905.

Cotypes, 17 specimens, No. 451, Museum California Academy of Sciences, and 12 specimens in author's collection.

22. **Camponotus (Myrmamblys) macilentus duncanensis,** new variety.

Worker major. Length 5—5.5 mm.

Distinctly smaller than the two preceding forms. Head proportionally shorter, with less convex cheeks and broader clypeus, the antennal scapes extending nearly one-quarter their length beyond the posterior corners of the head. The punctures on the mandibles, clypeus and head and the foveolæ on the pro- and mesonotum are more feebly developed, so that the head is much more shining. The color is much like that of *barringtonensis,* pale ivory yellow, but there are no dark markings on the head and thorax and the bands on the gaster are narrow and rather sharply defined, reddish brown, the mid-dorsal marking either absent or present only as a narrow, more or less interrupted line.

Worker minor. Length 4—4.5 mm.

Colored like the worker major, but some specimens have the meso- and epinotum and a cloud on the vertex pale brownish. The bands on the gaster are usually reduced to brown transverse lines and the mid-dorsal markings are frequently absent.

Female (deälated). Length 7 mm.

Colored like the worker major, i. e. without any dark markings on the head and thorax. The gastric bands are well-developed, but there are mid-dorsal markings only on the third and fourth segment, where they appear as small spots. The head is shining, owing to the very feeble development of the punctures.

Male. Length 4.5—5 mm.

Differing from the male of *jacobensis* in color, the body and legs being rather dark brown, with paler brown thorax and antennæ. The wings are rather opaque.

Described from a single female, six major workers, 17 minor workers and four males taken August 13-14, 1906, by Dr. Williams on Duncan Island.

Cotypes, 14 specimens, No. 452, Museum California Academy of Sciences, and 12 specimens in author's collection.

The six specimens regarded as major workers may possibly be mediæ, but the whole appearance of the series, and especially of the female, suggests a distinct variety characterized by the small stature of all the castes and a very incomplete polymorphism of the worker caste in particular. The coloration of the male is peculiar.

23. Camponotus (Myrmamblys) macilentus albemarlensis, new variety.

Worker major. Length 7—7.5 mm.

Closely resembling the vars. *jacobensis* and *barringtonensis*, but the head is slightly broader in front and more nearly rectangular, and the clypeus is distinctly broader in proportion to its length, being only a little longer than broad and much less distinctly carinate behind. The antennal scapes do not reach beyond the posterior corners of the head. On the mandibles, clypeus and head the punctures are much finer than in *jacobensis* so that the surfaces are more shining. The color is similar to that of *barringtonensis* and *duncanensis,* being pale, ivory yellow, the gaster, coxæ and legs a little paler than the head and thorax, which are immaculate. The brown bands on the gaster are well-developed, darker than in *duncanensis,* but paler than in *jacobensis,* and there are distinct though interrupted portions of the mid-dorsal streaks. The knees are brownish, the antennæ and tarsi reddish.

Described from two specimens taken by Dr. Williams during May, 1906, on Mt. Cowley, South Albemarle.

Cotypes, 2 specimens, No. 453, Museum California Academy of Sciences.

24. Camponotus (Myrmamblys) macilentus vulcanalis, new variety.

Worker major. Length 5—6 mm.

Head and clypeus broad as in the preceding variety, but the head with somewhat more convex sides. Antennal scapes extending a distance equal to their greatest width beyond the posterior corners of the head. Clypeal carina obsolete. Thoracic dorsum in profile nearly straight, much less convex than in the other forms. Color brownish yellow, thorax immaculate, vertex sometimes faintly clouded with brown. The bands on the gaster are broad and rather dark brown but ill-defined anteriorly, their mid-dorsal expansions faint or lacking. The puncturation of the head is nearly as well developed as in the var. *jacobensis*.

Worker minor. Length 3.5—4 mm.

Resembling the worker major, but paler in color, with the gastric bands narrower and their mid-dorsal expansions obsolete.

Female. Length nearly 9 mm.

Very similar to the worker major in the form of the head and in color. The antennal scapes extend nearly one-quarter their length beyond the posterior corners of the head. There is a well-defined brown patch on the ocellar region and the gastric bands are broad and dark brown, covering the greater part of each segment, except the first. The wings are almost colorless, the veins and stigma brownish yellow.

Male. Length 6.5 mm.

Very similar to the male of the var. *jacobensis,* but the head and gaster are of a distinctly darker brown tint.

Described from three major workers, three minor workers, four females and five males taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Albemarle Island. Some of these specimens are very imperfect and part of them are greasy. The absence of color in the wings may be due to fading with age. The markings on the gaster of the major workers and females are deeper and more vivid, however, than in the fresher specimens of the var. *albemarlensis* taken by Dr. Williams, so that I do not hesitate to regard the two varieties as distinct. Two of the specimens, a worker minor and a damaged female, are labelled as taken at Tagus Cove. The dates on the other specimens indicate that they were taken at different times and possibly in other parts of Albemarle.

25. Camponotus (Myrmamblys) macilentus hoodensis, new variety.

Worker major. Length 7.5—8 mm.

Resembling the two preceding varieties in the structure of the head and clypeus and in puncturation. The antennal scapes extend a distance equal to their greatest width beyond the posterior corners of the head. The color is pale ivory yellow, the gaster, coxæ and legs whitish, the head and thorax are immaculate and the bands and their mid-dorsal expansion on the gastric segments are narrow and so very faint as to be scarcely discernible. The knees, mandibles and tarsi are brownish yellow.

Worker minor. Length 5—6 mm.

Resembling the worker major but even slightly paler in color, almost white. The clypeus is as broad as long and distinctly carinate. The antennal scapes extend about one-third their length beyond the posterior corners of the head. The mandibles are scarcely darker than the head, with reddish teeth.

Described from five major and five minor workers taken by Dr. Williams in November, 1905, on Hood Island "under stones". This variety is readily distinguished by its very pale color.

Cotypes, 6 specimens, No. 454, Museum California Academy of Sciences, and four specimens in author's collection.

26. **Camponotus (Myrmamblys) macilentus narboroënsis,** new variety.

Female. Length of head and thorax 4 mm.

Head but little longer than broad and nearly as broad in front as behind. Clypeus a little broader in front than behind. The color is reddish yellow, the pleuræ, coxæ and femora pale yellow, the tibiæ, tarsi and antennæ more reddish, the mandibles scarcely darker than the head. Wings with a distinct yellowish tinge. The gaster and petiole are missing.

A single, greasy and defective specimen taken by the "Albatross" in 1899 (U. S. Nat. Mus.). More and better material will be required to establish the status of this form, which seems to represent a distinct color variety.

27. **Camponotus (Myrmamblys) macilentus bindloënsis,** new variety.

Worker major. Length about 8 mm.

Head large and rather broad, with distinctly rounded sides, slightly narrowed in front; cheeks without transverse impressions. Clypeus subrectangular, distinctly longer than broad, scarcely broader in front than behind, with distinct carina. Antennal scapes extending a distance equal to their greatest width beyond the posterior corners of the head. Epinotum in profile convex, without distinct base and declivity. Petiole with the upper border rather blunt and feebly emarginate in the middle. Brownish yellow, with the pronotum, coxæ, femora and tibiæ pale yellow. Vertex faintly clouded with brown; gaster with broad, dark brown bands on the segments, but without mid-dorsal streaks. Mandibles red, with black teeth. Puncturation of head well developed, as in the var. *jacobensis.*

Worker minor. Length 3.5 mm.

Resembling the worker major but the posterior half of the head, the whole thorax and petiole pale brown as are also the paler portions of the gaster so that the bands of the latter are not sharply contrasted with the other portions of the segments.

Described from a single worker major and two minor workers (one very immature) taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Bindloe Island.

28. **Camponotus (Myrmamblys) macilentus**, variety.

A single major worker and two minor workers taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Tower Island probably represent a distinct variety, but all have lost the gaster and of the worker major only the thorax and legs remain. The specimens are small and all are very pale, like the var. *hoodensis,* the head and thorax being immaculate brownish yellow, the coxæ and legs white. The mandibles, except their teeth, are scarcely darker than the remainder of the head. The specimens are so imperfect that I refrain from introducing a new name.

29. **Camponotus (Myrmorhachis) planus** F. Smith.

Camponotus planus F. Smith, Zool. Coll. made by H. M. S. "Peterel", Proc. Zool. Soc. London 1877, p. 83 ☿.

Worker major. Length 5—6 mm.

Head rather large, trapezoidal, decidedly broader behind than in front, excluding the mandibles a little longer than broad, very convex above, flat beneath, with feebly convex sides, feebly and broadly excised occipital border and a distinct transverse impression on the cheeks. Eyes moderately large, flat, situated well behind the middle of the head. Mandibles short, convex, 5-toothed. Clypeus subrectangular, as broad as long, a little broader in front than behind, convex but not carinate in the middle, transversely impressed just behind the anterior margin, which is feebly but distinctly excised in the middle and rather deeply emarginate on each side. Frontal area very small, distinct, triangular. Frontal carinæ rapidly diverging in front, but parallel behind. Antennal scapes stout, funiculi slender, the former flattened, curved and very narrow at their insertions, extending about one-quarter their length beyond the posterior corners of the head. Thorax a little longer than the latter, including the mandibles, laterally compressed behind, with flat pleuræ; promesonotal and mesoëpinotal sutures very sharp and distinctly impressed; pronotum flat above, including the neck nearly as long as broad; mesonotum much narrower, flat, almost circular when seen from above, bluntly marginate on the sides; epinotum nearly as broad as the mesonotum, a little longer than broad, subcuboidal; in profile with the base a little longer than the declivity, both distinctly concave, the former horizontal, the latter sloping and separated by a sharp transverse ridge, which is slightly emarginate in the middle so that the apex of the epinotum viewed obliquely or from above is feebly bidentate. Petiole nearly as high as the epinotum, its superior margin blunt, broadly rounded and entire, its posterior surface flat, its anterior surface formed of two subequal planes meeting at an obtuse angle, the more ventral plane vertical and parallel with the posterior surface. Gaster rather large, elliptical; legs rather long and stout.

Opaque; mandibles, gula and sides of head, occipital corners, declivity of epinotum and sutures of thorax shining. Whole body very densely and finely punctate, the mandibles, cheeks, sides of head, antennal scapes, legs and gaster also with somewhat larger, sparser, shallow punctures which bear the hairs and pubescence; the punctures on the sides of the thorax somewhat coarser than those on the dorsum.

Hairs short, erect, glistening, pale yellow, rather obtuse, sparse on the head, thorax and border of the petiole, more abundant on the gaster, absent on the cheeks. Pubescence short, appressed and sparse, but easily visible on the sides of the head, dorsum of pronotum and on the legs, especially on the tibiæ, on the gaster much denser and longer, so that it hides the sculpture and produces a silky or bronzy gray reflection.

Black; mandibles, except the teeth, front of clypeus, cheeks and sometimes the sides of the head, including the posterior corners, anterior portions of frontal carinæ, antennæ, legs, including the coxæ, rich ferruginous red; venter dark brown.

Worker minor. Length 3.5—4.5 mm.

Resembling the worker major, but the head smaller and proportionally longer, with more rounded posterior corners, the clypeus feebly carinate behind, the eyes situated a distance about equal to their length from the posterior corners. Antennal scapes much more slender, reaching about one-half their length beyond the occipital border of the head. Thoracic sutures less deeply impressed, the base of the epinotum more concave and the ridge separating the base from the declivity more pronounced and somewhat more distinctly bidentate.

Sculpture, pilosity and color practically the same as in the worker major.

Female. Length 8.5—9 mm.

Head smaller and narrower than in the worker major, the sides and posterior border straight, the antennal scapes less flattened. Thorax rather long, elliptical from above, a little broader than the head; epinotum with convex, rounded base passing gradually into the longer, sloping declivity. Superior border of the petiole distinctly emarginate in the middle.

Sculpture of the head resembling that of the worker major but the remainder of the body is more shining owing to its much finer and more superficial puncturation.

Pilosity like that of the worker, but the shining appressed pubescence on the gaster is distinctly shorter and sparser so that the black surface is more apparent and much more shining.

Color as in the worker major, but the anterior border of the pronotum and the mesonotum about the wing insertions more or less ferruginous red. Wings long (nearly 10 mm.), faintly brownish and rather opaque, with pale brown veins; pterostigma with a long hyaline area in the middle.

Male. Length 5 mm.

Head, including the eyes and mandibles, a little longer than broad, broadly and semicircularly rounded behind. Cheeks straight and subparallel. Eyes large and convex. Clypeus rather convex, broader than long, with straight, entire anterior border. Mandibles small and rather broad, with only the acute apical tooth developed. Antennæ very slender, the scapes terete, reaching only two-fifths their length beyond the posterior border of the head. Thorax broader than the head, mosonotum as broad as long, subhexagonal. Epinotum resembling that of the female. Petiole thick and low, subcuboidal, with flattened dorsal surface, seen from above transversely oblong, twice as broad as long. Gaster somewhat flattened dorsoventrally, with very slender genital appendages. Legs very slender.

Sculpture like that of the female; head, including the mandibles, subopaque; thorax and gaster more shining, densely and very finely shagreened, except the mesonotum and scutellum, which are more sharply shagreened and subopaque.

Hairs grayish, much less abundant than in the worker, absent on the thorax and almost absent on the head. Pubescence very feebly developed, even sparser on the gaster than in the female.

Black or dark brown; mandibles dull yellowish, anterior portion of head and clypeus, antennæ, epinotum, thoracic sutures, petiole, legs and tip of gaster more piceous. Wings colored as in the female.

Described from 10 major workers, five minor workers, three females and a single male taken during October 1905 by Dr. F. X. Williams from a single colony at Cormorant Bay, Charles Island. The label bears a note that the species is "common in old logs". I have also before me 18 well-preserved males taken by the "Albatross" on the same island (acc. 21,699, U. S. Nat. Mus.).

The specimen from which Smith drew his description was evidently a worker minor.

C. planus belongs to a group of small *Camponoti* which Forel has recently segregated as the subgenus *Myrmorhachis.* It comprises several neotropical forms rather closely related to *planus,* notably *quadrilaterus* Mayr, *rectangularis* Emery, ***bidens*** Mayr, *mucronatus* Emery. So far as known the American species all nest in hollow twigs or in dead wood.

30. **Camponotus (Myrmorhachis) planus peregrinus** Emery.

Camponotus peregrinus Emery, Ann. Soc. Ent. France, 63, 1893, p. 91 ☿.

Camponotus (*Myrmorhachis*) *peregrinus* Forel, Rev. Suisse Zool. 22, 1914, p. 274 ☿.

As I have seen no specimens of *planus* from Chatham Island, I regard the form described by Emery as possibly of varietal rank, although it is by no means certain that his specimen, which was taken by Dr. George Baur on the vessel, came originally from the island. I translate Emery's description in its entirety, although it contains very little that does not agree with specimens of the typical *planus.*

"*Worker minor.* Black, opaque, with the mouth, antennæ and legs, excepting the coxæ, ferruginous; pilose, with the head and thorax very sparsely pubescent, the gaster with dense griseoæneous, shining, silky pubescence. Head subrectangular, clypeus in front broadly rounded, obtusely carinate, mandibles short, 4-toothed, eyes at the posterior part of the head. Thorax with distinct sutures, dorsally depressed, sides obtusely marginate, epinotum behind abruptly truncate and obsoletely bituberculate, its declivity concave, somewhat shining. Petiole truncate behind. Head and thorax very densely, petiole more sparsely punctate; gastric segments transversely rugulose-punctate; mandibles, scapes and legs delicately punctate; legs without erect hairs. Length 4.3 mm.

"This species belongs to an exclusively American group, and among the species known to me in nature, it approaches most closely *C. quadrilaterus* Mayr, from which, however, it differs considerably. The head is a little longer than broad if it be regarded as truncated in front at a level with the insertions of the mandibles. The eyes are very close to the occipital border, from which they are separated by a space less than half the length of an eye. This character is found also in the minor worker of *C. quadrilaterus*. The clypeus is broadly rounded in front, with a very blunt, median carina. The antennæ are long, the scapes surpass the occipital border by more than one-third their length. The thorax is rather slender (total length 1.9 mm., width of pronotum 0.9 mm.), with the sutures well-marked but not impressed, the dorsum depressed, bordered by obtuse ridges. The epinotum is narrowed posteriorly, where it is sharply truncated, the base rising a little at its posterior end and nearly in the form of a right angle with the declivity, which is concave longitudinally; the ridge separating the two surfaces is very feebly notched, so that if the insect is viewed obliquely from the side, the epinotal base seems to terminate on each side in a pointed projection. The petiolar scale is truncated behind, i. e. its posterior surface is flat and vertical when viewed in profile; it forms a very sharp and feebly rounded angle with the anterodorsal surface; the anterior and dorsal surfaces form a very obtuse angle.

"The head and thorax are opaque and covered above with very fine and dense thimble-punctures; the inferior surface of the head is shining; the sides of the thorax are a little less opaque than the dorsum and covered with coarser punctures; the epinotal declivity is rather shining and irregularly and transversely rugose. The mandibles and appendages are opaque and covered with exceedingly fine and dense punctures. The anterodorsal surface of the petiole has a sculpture very much like that of the thorax, but the punctures tend to flow together to form transverse striæ. This transverse confluence is even more pronounced on the gaster, the sculpture of which is almost completely concealed by the ashen, slightly bronzy pubescence which forms a pelt. The pubescence of the head and thorax is composed of short, scattered hairs. The coxæ are finely and densely pubescent. There are rather numerous, erect, yellowish hairs on the thorax and gaster, shorter and sparser on the front.

"Perhaps this ant is not specifically different from *C. planus* F. Smith, to which it seems to be very closely related. The

English author says nothing about the bronzy pubescence of the gaster and describes the petiole as having a different form."

The omission to which Emery refers was probably due to the age of the specimen described by Smith, since it was taken by Darwin on the voyage of the "Beagle" and not described till 42 years later. Smith's description of the petiolar node as "incrassate, narrow, the sides nearly parallel, rounded above", is not so very inapplicable to specimens which undoubtedly belong to the true *planus*.

31. **Camponotus (Myrmorhachis) planus isabelensis,** new variety.

Worker major. Length 6.5—7 mm.

Somewhat larger than the typical *planus,* with the sides of the head decidedly more opaque and with larger, scattered punctures. The cheeks bear short, erect, blunt hairs. The hairs on the front, vertex and thoracic dorsum are more abundant, and those on the gaster are somewhat shorter, the pubescence on the legs, especially on the tibiæ, is distinctly longer and less appressed.

Worker minor. Length 4—5.5 mm.

Very similar to the worker major in sculpture, pilosity and pubescence. The base of the epinotum is more concave in profile and much more distinctly bidentate posteriorly than in the worker minor of the typical form, and the border of the petiole is distinctly more acute.

Female. Length about 8 mm.

Resembling the worker major and differing from the female of the typical *planus* in pilosity. The pubescence on the gaster is noticeably longer and denser and more as in the worker. The petiolar border is entire.

Male. Length 5—5.5 mm.

Indistinguishable from the male of the typical form.

Described from eight major and three minor workers taken by Dr. Williams in 1905 on Cowley Mt., South Albemarle, and 16 major workers, 13 minor workers, five females and 27 males taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on the same island.

Cotypes, 5 specimens, No. 455, Museum California Academy of Sciences, and 6 specimens in author's collection.

This variety is readily distinguished from all the other forms of *planus* by the erect, stubby hairs on the cheeks, the more abundant pilosity of the head and thorax and the longer pubescence on the legs of the worker and female.

32. Camponotus (Myrmorhachis) planus indefessus, new variety.

Worker major. Length 5—6 mm.

Body shorter and stouter than in the typical *planus* and var. *isabelensis,* the head larger and broader. Sculpture, pile and pubescence as in *isabelensis,* but the cheeks without erect hairs. The ferruginous red color extends back further on the head, covering the clypeus, cheeks and front and is suffused with the black on the sides and posterior corners. The antennæ and legs, excluding the coxæ, are somewhat more yellowish. The ridge between the base and declivity of the epinotum is scarcely impressed in the middle.

Worker minor. Length 4—4.5 mm.

Very similar to the worker major, even in the color of the head. Epinotum very feebly bidentate.

Described from six major and three minor workers taken from a single colony by Dr. Williams, Oct. 25-28, 1905, on Indefatigable Island.

Cotypes, 3 specimens, No. 456, Museum California Academy of Sciences, and 6 specimens in author's collection.

33. Camponotus (Myrmorhachis) planus santacruzensis, new variety.

Worker major. Length 5.5—6 mm.

Like the typical *planus* in stature, in the size of the head, sculpture, pilosity and color, but the hairs are even sparser on the dorsal surface of the head and thorax and the pubescence on the scapes, legs and gaster is distinctly shorter and finer, so that the gaster has a less silky lustre. The base of the epinotum is straight and horizontal in profile, not concave, and the ridge between the base and declivity is semicircular and entire, without indications of teeth.

Worker minor. Length 4.5—5 mm.

Like the worker major, but the epinotum is slightly concave in profile just in front of the ridge between the base and declivity. This ridge is very narrow and indistinctly bidentate.

Female. Length 10 mm., wings nearly 11 mm.

Larger than the female of the typical *planus* and var. *isabelensis* and of a deeper black color, the thorax being without red markings. The pubescence on the gaster as in the type.

Male. Length 5—6 mm.

Like the male of the typical *planus,* except that the body and appendages are somewhat darker and more blackish.

Described from five major workers, 11 minor workers, seven females and five males taken during November, 1905. by Dr. Williams from a single colony on Indefatigable Island. Although this form occurs on the same island as the preceding it is nevertheless so different that I am compelled to regard it as a distinct variety.

Cotypes, 15 specimens, No. 457, Museum California Academy of Sciences, and 15 in author's collection and 8 in the Museum of Comparative Zoology.

34. Camponotus (Myrmorhachis) planus fidelis, new variety.

Worker major. Length 5.5—6 mm.

Resembling the var. *indefessus* in stature, in the size of the head, pilosity and sculpture, but the pubescence of the head and thorax is much shorter and less conspicuous. On the gaster it is dense and rather long and has a pronounced silvery lustre. The epinotum differs, however, from that of all the preceding varieties, the base being scarcely longer than the declivity and perfectly straight and horizontal in profile. The ridge separating it from the declivity is straight, transverse, rather blunt and entire, without any indications of teeth. The reddish color of the anterior part of the head is suffused with the black even on the vertex and occiput and the pronotum and basal gastric segment are also distinctly reddish.

Worker minor. Length 3.5—4 mm.

Very similar to the worker major even in the structure of the epinotum. The red parts of the body, however, are distinctly more yellowish.

Female (deälated). Length 9 mm.

Colored like the worker major but with the anterior and lateral portions of the mesonotum, the mesopleuræ above and the sutures of the thorax and gaster ferruginous red. The pubescence on the gaster as in the female of the typical *planus*. The border of the petiole is blunt, transverse and entire.

Described from two major and six minor workers and a single female taken by Dr. Williams, Oct. 19-24, 1905, on Barrington Island. I do not regard the more reddish color of the head and thorax of all these specimens as due to immaturity.

Cotypes, 5 specimens, No. 458, Museum California Academy of Sciences, and 4 specimens in author's collection.

35. **Camponotus (Myrmorhachis) planus fernandinensis,** new variety.

Worker major. Length 6.5—7 mm.

With the stature and size of the head of the typical *planus* and very similar pilosity and color. The pubescence on the gaster, however, is shorter and dull grayish, without the silky lustre of many of the other varieties. The pubescence on the legs and scapes is very short and inconspicuous. The sculpture is most like that of the var. *isabelensis,* although the sides of the head are somewhat more shining and more feebly punctate as in the typical *planus*. The base of the epinotum is concave in profile and the ridge between the base and declivity is rather sharp and feebly emarginate in the middle.

Described from 10 specimens taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Narborough Island.

Cotypes, 1 specimen, No. 459, Museum California Academy of Sciences, and 4 specimens in author's collection.

This variety is most distinctly characterized by the short, dull grayish pubescence of the gaster.

36. **Camponotus (Myrmorhachis) planus pinzonensis,** new variety.

Worker major. Length 6.5—7 mm.

Very similar to the preceding variety and with the same kind of pubescence on the gaster, but the pubescence on the head, thorax, scapes and legs is more abundant though not longer. The base and declivity of the epinotum are subequal in profile and the former is perfectly straight and horizontal, the latter straight above; the ridge separating them is transverse and entire, without any indications of teeth.

Worker minor. Length 3.5—4.5 mm.

Very similar to the worker major, but the epinotum has the base feebly concave and bidentate behind.

Female. Length 7.5—8 mm., wings 8.5 mm.

Smaller than the female of the typical *planus,* with the pubescence of the gaster precisely the same as in the worker. The superior border of the petiole is distinctly emarginate in the middle. The pronotum and paraptera are tinged with ferruginous red and the legs and antennæ are more yellowish than in the worker. The head and body are more distinctly shagreened and much less shining than in the typical *planus.*

Described from five major workers, three minor workers and six females taken by Dr. Williams, August 13-14, 1906, on Duncan Island.

Cotypes, 6 specimens, No. 460, Museum California Academy of Sciences, and 8 specimens in author's collection.

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XV

THE ANTS OF COCOS ISLAND[1]

BY

WILLIAM MORTON WHEELER

Cocos Island, owing to its isolated position some 300 miles off the west coast of Costa Rica, is of unusual interest in connection with the origin of the fauna and flora of the Galapagos Archipelago, a problem which, in turn, according to Scharff[2], "presents the key to the solution of the most complex and intricate questions concerning the American fauna with which we are confronted." While in charge of the Hopkins-Stanford Galapagos Expedition, Snodgrass and Heller[3] explored the island June 30 to July 3, 1899, and gave such an interesting and succinct account of its topography and biota that it seems

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[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 138.

[2] *Scharff, R. F.* Distribution and Origin of Life in America. New York, Macmillan Co., 1912.

[3] *Snodgrass, R. E., and Heller, E.* The Birds of Clipperton and Cocos Islands. Papers from the Hopkins-Stanford Galapagos Expedition. 1898-1899, XI. Proc. Wash. Acad. Sci. 4, 1902, pp. 501-520.

June 16, 1919

appropriate to quote most of their remarks by way of introduction to the present paper:

"Cocos Island lies in latitude 5° 33′ north and longitude 87° 2′ west. It is about four miles long in its longest diameter, which is east and west, and has a circumference of about thirteen miles. Its highest part, on its western side, is visible from a distance of sixty miles. The island is mountainous, presenting on all sides perpendicular cliffs, and above these steep slopes and canyons. The northern side, however, has several indentations. * * * Streams of fresh water flow down on all sides of the island, in most places pouring over the cliffs into the ocean. * * *

"The rock composing Cocos Island is volcanic, but is not made up of layers of lava as is the case with the Galapagos. Rivillagigido and Guadalupe Islands, but, at least about Chatham Bay, forms one solid mass as does the volcanic rock on Clipperton Island. The surface is greatly eroded, there being everywhere, as before stated, numerous deep canyons, and the rock is almost everywhere covered by a rich shallow soil.

"The climate resembles that of Clipperton, being extremely humid. The island lies in the warm counter equatorial current which flows past Cocos in an easterly direction towards Panama Bay, where its waters are deflected to the north and south. With the currents flowing as they now do, it is apparently impossible for plants or animals to be carried by them from the mainland to Cocos Island.

"The vegetation is extremely rich, though the number of plant species is few. Everywhere a dense covering of tall trees and smaller undergrowth clothes the irregular mountain slopes and ridges. In this respect Cocos strongly contrasts with any other island of the eastern tropical Pacific. Guadalupe Island, the Rivillagigido and Galapagos archipelagos are for the most part dry and barren, even the wettest parts of the Galapagos being far less humid and less thickly covered with vegetation than is Cocos.

"Animal life on Cocos Island is very scarce. Besides the birds there is present a rat, *Mus norwegicus,* brought hither by vessels that have touched here for wood and water. A lizard, *Anolis townsendi,* is rather numerous. With the exception of a snake reported by Townsend this lizard and the birds are the only native land vertebrates known. Hogs have been introduced and now run wild on the island. Insects are very scarce. One *Cicada* occurs but is rare. We obtained one nymph of it in July but saw no adults. A fly, *Leucomelina pica,* is somewhat plentiful. There is one ant, *Tetramorium auropunctatum,* that is extremely numerous, occurring in great numbers on the leaves of all the vegetation. It is minute but its bite is excessively annoying, causing an almost unendurable irritation of the skin. Its presence makes traveling on the island exceedingly disagreeable."

Forel in 1892[4] published the first and up to the present time the only account of the ants of Cocos Island. Among the specimens collected for him by Mr. P. Biolley he recognized only four forms: *Tetramorium guineënse* Fabr., *Wasmannia auropunctata* Roger., *Prenolepis guatemalensis* var. *cocoënsis* Forel and *Camponotus biolleyi* Forel; the latter two being peculiar to the island.

Several months ago Dr. E. C. Van Dyke, at the request of Dr. F. X. Williams, sent me for study the Cocos Island ants which he collected during November, 1905, while a member of the California Academy Expedition to the Galapagos. The specimens comprise seven forms, four of which are identical with those recorded by Forel, but the three others, *Euponera (Trachymesopus) stigma* Fabr., *Odontomachus hæmatoda* L. subsp. *insularis* and a new *Camponotus (C. cocosensis)* constitute a significant addition to the ant-fauna of the island. With the exception of the tropicopolitan "tramp", *Tetramorium guineënse,* of Old World origin, none of the forms is known to occur in the Galapagos Islands and all are neotropical or have strongly neotropical affinities. *Camponotus biolleyi* and *cocosensis* are related to *C. lindigi* Mayr and *C. novogrenadensis* Mayr respectively of Central and South America. The *Wasmannia, Euponera* and *Odontomachus* are well known species abundant and widely distributed through the neotropical region, and the var. *cocoënsis* is merely a form of *Prenolepis vividula* Nyl., which is also widely distributed in the American tropics and occurs even in the hot-houses of North America and

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[4] *Forel, A.* Quatre Notices Myrmécologiques. II Fourmis de l'Île de Coco, etc. Ann. Soc. Ent. Belg. 46, 1902, pp. 176-178.

Europe. Hence the only forms really endemic and characteristic of Cocos Island are the two species of *Camponotus.*

The ants, therefore show the same relation as the diurnal Lepidoptera to the Galapagos fauna of which Williams says[5]: "Only two species of butterflies were taken on Cocos Island, and neither of them occurs in the Galapagos." It is evident that the Cocos ants are decidedly tropical whereas those of the Galapagos are mainly such as belong to subtropical or temperate regions or at any rate to the cooler or subalpine regions in the New World tropics. Williams calls attention to this difference in the climates of the two island regions. It comes out strongly also in the Cocos plants which have been recently studied by Stewart.[6] This author records 77 species of vascular plants from Cocos Island, 20 of which are ferns. There are only eight endemic species, one of which is a *Cecropia (C. pittieri).* Thus only 8.69 percent of the plants are endemic, whereas the percentage of endemicity in the Galapagos is 40.9. There are, however, 27 species common to the two regions, although 11 of them are ferns. Botanists have repeatedly called attention to the great difference between the Cocos and Galapagos plants, but this would be expected as a result of the pronounced climatic differences. The data derived from a study of the ants are too meager to enable me either to accept or to reject Stewart's view that Cocos is a true oceanic island of more recent origin than the Galapagos and that it has received its biota as "flotsam and jetsam" from the Central American mainland.

Family FORMICIDÆ

Subfamily PONERINÆ

1. **Euponera (Trachymesopus) stigma** (Fabricius)

Formica stigma Fabricius, System. Piez. 1804, p. 400 ☿.

Ponera quadridentata Roger, Berl. Ent. Zeitschr. 4, 1860, p. 285 ☿.

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[5] *Williams, F. X.* The Butterflies and Hawk-Moths of the Galapagos Islands. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906, III. Proc. Cala. Acad. Sci. (4) 1, 1911, pp. 289-322, 2 pls.

[6] *Stewart, A.* Notes on the Botany of Cocos Island. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906, V. Proc. Calif. Acad. Sci. (4) 1, 1912, pp. 375-383.

Ponera americana Mayr, Verh. zool. bot. Ges. Wien, 13, 1862, p. 722 ☿ ; *ibid* 28, 1878, p. 663, ☿ ♀.

Ponera stigma Roger. Verzeich. Formicid. 1863, p. 16; Emery, Ann. Mus. Civ. Genoa, 25, 1887, p. 434 ☿ ; Dalla Torre, Catalog. Hymen. 7, 1893, p. 42.

Pachycondyla (Pseudoponera) stigma Emery. Ann. Soc. Ent. Belg. 45, 1901, p. 46.

Euponera (Trachymesopus) stigma Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 85.

Dr. Williams took a dozen workers which are indistinguishable from specimens from various parts of the American tropics (Southern Florida, West Indies, Mexico, Central and South America) in my collection. A variety of the species, *quadridentata* F. Smith, occurs in the East Indies.

2. **Odontomachus hæmatoda insularis** Guérin

Odontomachus insularis Guérin, Icon. Règne Anim. 7. 1845, p. 423 ☿ ; Lucas, in Ramon, Hist. Fis. Cuba, 7, 1857, p. 757, pl. 18, Fig. 7 ☿ ♀ ♂.

Odontomachus hæmatodes subsp. *insularis* Emery, Bull. Soc. Ent. Ital. 22, 1890, p. 44, *nota*.

? *Atta brunnea* Patton, Amer. Natural. 1894, p. 618.

Odontomachus hæmatoda subsp., *insularis* Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 115.

Fifteen workers agreeing in all respects with specimens from Georgia, Florida, West Indies and Central America in my collection.

Subfamily MYRMICINÆ

3. **Tetramorium guineënse** (Fabricius)

Seven workers and three deälated females. This is a very common tropicopolitan species, which occurs also in the Galapagos Islands and even in hot-houses of temperate regions as it is frequently introduced with plants from the West Indies and the adjacent mainland. A portion of the rather extensive synonymy of this ant is given in my "Ants of the Galapagos Islands," p. 274.

4. Wasmannia auropunctata (Roger)

Tetramorium? auropunctatum Roger, Berl. Ent. Zeitschr. 7, 1863, p. 182 ☿ ♀ ♂.

Tetramorium auropunctatum Forel, Bull. Soc. Vaud. Sc. Nat. (2) 20, 1884, p. 375 ☿; Mayr, Verh. zool. bot. Ges. Wien, 37, 1887, p. 623; Dalla Torre, Catalog. Hymen. 7, 1893, p. 130.

Ochetomyrmex auropunctatus Forel, Ann. Soc. Ent. Belg. 30, 1886, C. R. p. XLIX.

Tetramorium (Xiphomyrmex) auropunctatum Forel, Mitth. Schweiz. Ent. Ges. 7, 1887, p. 385.

Wasmannia auropunctata Forel, Trans. Ent. Soc. London, 1893, p. 383 ☿ ♀ ♂.

Seven deälated females and numerous workers taken by Dr. Williams in November, 1905, and seven workers taken by the "Albatross" in 1899 (U. S. Nat. Mus.). The females are considerably darker than West Indian specimens but of about the same color as Brazilian and Colombian specimens in my collection. This is the ant to which Snodgrass and Heller refer (*supra* p. 301) under the old name *Tetramorium auropunctatum* as occurring in great numbers on the leaves on Cocos Island and as making "traveling on the island exceedingly disagreeable." It is not the bite, however, but the sting which is so irritating. There is also a note on Dr. Williams' label to the effect that his specimens were found on rocks and vines and had a "fiery sting." This ant is well known in Porto Rico under the name of "albayarde". Mr. R. H. Van Zwalenberg wrote me from Mayaguez: "In regard to *Wasmannia auropunctata* Roger I would say that as a rule this species is not pugnacious even when handled under ordinary collecting circumstances. It has a burning sting, however, though not so severe as that of *Solenopsis geminata*. The ferocity of the "albayarde" is proverbial among the natives; when present during the coffee picking it gets under the workers' clothes and then gives a good account of itself." This difference in behavior is easily explained. When one opens the populous nests under stones or logs the minute workers are unable to penetrate the thick skin of one's hands with their stings, but can easily thrust them into the thinner skin of the covered parts of the body.

Subfamily CAMPONOTINÆ

5. Prenolepis vividula guatemalensis cocoënsis Forel.

Prenolepis guatemalensis Forel var. *cocoënsis* Forel, Ann. Soc. Ent. Belg. 46, 1902, p. 178 ☿.

This variety is very close to the var. *itinerans* Forel, the worker being "of the same form and stature, but the color is a little duller, the legs, especially the tibiæ are brownish, the surface is more opaque, and the hairs are a little longer and more abundant than in *itinerans* or the typical *guatemalensis.* The epinotum is also a little more elevated and more gibbous than in the type of *itinerans,* with deeper mesoëpinotal suture. The legs and hairs are dark-colored, strikingly contrasting with the yellowish body."

Thirteen workers taken by Dr. Williams agree with Forel's description, except that the legs are concolorous with the body. Three females from the same colony are of the same color as the workers but distinctly paler than females of *itinerans* from the Galapagos Islands and have the head smaller, with much more rounded occipital corners and the hairs on the thorax shorter and less abundant. The specimens of *cocoënsis* were taken by Dr. Williams in rotten logs. Forel's name *'cocoënsis'* should probably be amended to read *"cocosensis"*.

6. Camponotus (Myrmobrachys) biolleyi Forel

Camponotus biolleyi Forel, Ann. Soc. Ent. Belg. 46, 1902, p. 177 ☿ ♂.

Camponotus (Myrmobrachys) biolleyi Forel, Rev. Suisse Zool. 22, 1914, p. 270.

Forel's description and four worker cotypes in my collection show that this species is very closely related to *C. lindigi* Mayr of Central and South America. Two minor workers taken by Dr. Williams agree perfectly with the cotypes. Biolley found the species nesting in dead branches and abundant on the ferns which form the undergrowth on Cocos Island.

7. Camponotus (Myrmamblys) cocosensis, new species

Worker major. Length 6.5–7 mm.

Head large, subrectangular, about 1.2 times as long as broad, a little narrower in front than behind, with straight sides and broadly excised occipital border, and rather convex dorsal surface, not truncated anteriorly. Eyes moderately large, flat, their anterior orbits at the median transverse diameter of the head. Mandibles rather small, convex, 4-toothed. Clypeus trapezoidal, longer than broad and distinctly broader in front than behind, rather flat, sharply carinate behind, with entire, feebly rounded anterior border. Frontal area very distinct, transverse, triangular. Frontal carinæ rapidly diverging in front, subparallel behind. Frontal groove distinct but not very deeply impressed. Antennæ slender, scapes not flattened, curved at the base, extending a little beyond the posterior corners of the head. Thorax decidedly narrower than the head, laterally compressed behind, evenly arcuate above in profile, with distinct promesonotal and feeble mesoëpinotal sutures. Pronotum somewhat broader than long, slightly convex, indistinctly marginate in the humeral region; epinotum with distinct base and declivity meeting at a very obtuse angle, the former sloping and straight, the latter more abrupt, marginate on the sides and longitudinally concave in the middle. Petiole rather low and thick, not as high as the epinotum, narrower than the posterior end of the epinotum, flat behind, rather strongly and evenly convex in front, with blunt, rounded and entire superior border. Gaster somewhat larger than the head, elliptical, slightly flattened dorsoventrally. Legs moderately long, anterior femora somewhat enlarged.

Subopaque; mandibles, posterior corners of the head and legs more shining. Surface of body distinctly shagreened and with piligerous punctures, which are small and shallow on the head, coarser, deeper and sparser on the thorax and gaster, finer, sharper and more numerous on the mandibles.

Hairs pale yellow, rather glistening, abundant, erect and rather long on the dorsal surface of the head, thorax, petiole and gaster, absent on the legs and antennæ. Pubescence yellowish, short, very dilute, distinct and appressed on the sides of the head, slightly longer and subappressed on the legs, extremely short and inconspicuous on the antennal scapes.

Dull yellowish ferruginous, mandibles, petiole and gaster and in some specimens the epinotum or whole thorax, brown; tips of mandibles and their teeth blackish, legs paler and more yellowish than the thorax, knees slightly infuscated, posterior borders of the gastric segments very narrowly yellowish.

Worker minor. Length 4.5–5 mm.

Differing from the worker major mainly in the structure of the head and in coloration. The head is somewhat longer than broad but the posterior corners are more rounded and the occipital border is straight, the clypeus is broader than long, the antennal scapes extend half their length beyond the occipital border, the eyes are large and distinctly convex. Thorax much like that of the worker major but higher and somewhat more gibbous in the mesonotal region and with the epinotal angle less distinct and more rounded and the declivity more sloping.

Sculpture and pilosity much as in the worker major but the surface of thorax, petiole and gaster and of the head behind the clypeus decidedly more shining and the puncturation of all these parts finer, denser and more indistinct.

The erect hairs are glistening white, somewhat more abundant and conspicuous than in the worker major and the pubescence longer and distinct on the whole dorsal surface of the head.

Head between and behind the eyes, thorax, petiole and gaster dark brown, the antennal funiculi byond the first joint and the knees distinctly infuscated, anterior portion of the head, including the mandibles yellowish, tips and teeth of the mandibles brown.

Worker media. Length 5.5–6 mm.

Intermediate in structure between the major and minor worker but with the coloration, sculpture and pilosity of the former.,

Described from six major workers, three mediæ and six minor workers taken in November, 1905, by Dr. Williams. The worker major resembles the corresponding phase of *C. novogrenadensis* Mayr in size and in the structure of the head and body, but the sculpture, pilosity and color are very different, the eyes are much larger, the antennal scapes somewhat longer, the thorax longer and less convex in the mesoëpinotal region, etc. The worker minor bears a strange resemblance to the worker minor of *C. biolleyi* but can be distinguished by its greater size, somewhat paler color, longer and lower epinotum, the more extensive infuscation of the antennal funiculi, the fuscous knees and the longer and somewhat less abundant erect hairs on the dorsal surface of the body.

Cotypes, 8 specimens, No. 461, Museum California Academy of Sciences, and 9 specimens in author's collection.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XVI

A NEW SPECIES OF THE HYMENOPTERUS GENUS SCLERODERMA FROM THE GALAPAGOS ISLANDS

BY

CHARLES T. BRUES
Bussey Institution for Research in Applied Biology

Scleroderma galapagense, new species

♀. Length 2.5–3 mm. Head and thorax pale brown to castaneous, abdomen fuscous or piceous, lighter toward apex and at the incisures; legs and antennæ pale yellowish brown; wings entirely absent. Head shining, faintly shagreened, with a few isolated punctures; one-half longer than wide; eyes one-fifth as long as the head, bare; ocelli absent; head widest at the middle, slightly narrowed behind with the angles rounded; malar space extremely short. Head below with sparse long pale backwardly curved hairs. Antennæ 13-jointed, reaching to the vertex, pedicel half as long as the scape and twice as long as thick; first flagellar joint minute, quadrate; second and third transverse, no longer than the first; fifth and following quadrate except the last which is twice as long as thick. Thorax of nearly even width, four times as long as broad except where the mesopleuræ project at the sides, propleuræ not visible from above; pronotum shagreened, twice as long as wide and slightly narrowed from its posterior angles to the neck. Mesonotum shagreened, rounded behind, two-thirds as wide as pronotum; axillæ (metanotum) triangular on the sides, meeting medially as a narrow band; propodeum with the sides nearly parallel, very slightly constricted near the base, declivous on its posterior third, its surface more coarsely shagreened than the mesonotum. Pleuræ shagreened, the propleura nearly smooth; mesopleura strongly protuberant. Abdomen smooth and shining, over twice as long as the thorax; with a few scattered whitish hairs laterally toward apex; first segment semicircularly rounded at apex; following ones with the margins straight; second and third subequal, each half wider than long; following growing shorter, apex acute. Legs stout, the middle tibiæ faintly denticulate, but not spinulose; claws slender, simple.

Described from six specimens, taken under a stone in a colony of *Prenolepis (Nylanderia) fulva* Mayr, subsp. *nesiotis* Wheeler on James Island, Galapagos at an altitude of 2000 ft.

This species is very similar to the other members of this cosmopolitan genus which is already known from many oceanic islands as well as from the continental areas. In the form of the head, eyes and thorax it seems to be most closely related to *S. sidneyanum* Westwood.

Holotype, No. 462, female, and one paratype, female, Museum California Academy of Sciences, and 4 paratypes in author's collection.

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A SYSTEMATIC STUDY OF THE ORGANISMS DISTRIBUTED UNDER THE NAME OF COCCOBACILLUS ACRIDIORUM D'HERELLE

BY

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Of the Bureau of Entomology, U. S. Department of Agriculture.

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A SYSTEMATIC STUDY OF THE ORGANISMS DISTRIBUTED UNDER THE NAME OF COCCOBACILLUS ACRIDIORUM D'HERELLE.

By R. W. Glaser,
Of the Bureau of Entomology, U. S. Department of Agriculture.*

A large amount of work has lately appeared dealing with d'Herelle's *Coccobacillus acridiorum* and his method of combating noxious grasshoppers. Some investigators have been able to confirm d'Herelle's results; others have been unable to do so, and since the entire subject seems to be in a state of confusion, I undertook a systematic study of a number of cultures which I obtained and which were distributed under the name of *Coccobacillus acridiorum* d'Herelle. As I suspected, some of the separate cultures proved to represent either different species or varieties of the same species. This fact may account for some of the contradictory views held by so many workers and it is my hope that this article will also demonstrate the need for attention to the ordinary principles of bacteriology which seem to be so persistently neglected by many entomologists.

In 1909 Dr. F. d'Herelle, while in the State of Yucatan, Mexico, noticed a heavy mortality in some flights of the destructive South American migratory locust *Schistocerca americana* Drury which arrived in the State from the borders of Guatemala. In 1911 the flights were all visited by this epizoötic and by 1912 it had reduced the number of locusts to such an extent that no invasion into Mexico occurred. In 1910 d'Herelle isolated a bacterium from the intestinal contents of cases of this disease. The organism was named by him *Coccobacillus acridiorum*. He was able to reproduce the disease and death by inoculating healthy grasshoppers with a culture of the Coccobacillus. These results were thought to be important by the Republic of Argentine which in 1911–12 requested d'Herelle to study the action of his bacterium against *Schistocerca paranensis* Burm, with a view towards its possible use in combating the pests. D'Herelle's methods apparently proved highly successful.

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*In co-operation with the Bussey Institution of Harvard University (Bussey Institution No. 139).

D'Herelle's method consisted in obtaining a virulent form of his organism by twelve successive passages and then spraying dilutions of his cultures over sections of land infested by grasshoppers. The insects became infected by eating the contaminated food. The passages were performed by inoculation and the organism was considered to be virulent when death occurred in eight hours. The organism at its maximum virulence was supposed to cause death in three hours.

In 1913 Sergent and L'heritier tried out the efficacy of *Coccobacillus acridiorum* against *Stauronotus maroccanus* in Algeria. A general epidemic failed to develop in the field and the authors suggest that this failure may have been due to the presence of two autochthonous bacilli in the locusts which may have had an immunizing effect.

Lounsbury in 1913 attempted to combat *Zonocerus elegans* with d'Herelle's organism, in South Africa, but was unsuccessful.

Barber and Jones in 1913 performed field experiments with *Coccobacillus acridiorum* in the Philippines in an endeavor to check the injurious *Oedalens nigrofasciatus* De Geer and *Locusta migratoroides* R. and F. The experiments failed to show any satisfactory results.

During 1914–15 Béguet, Musso and Sergent conducted a campaign in Algeria against *Schistocerca peregrina* Oliv. These workers used d'Herelle's method in combination with the ordinary mechanical methods used for fighting the pests. It was found that d'Herelle's bacterium could not be used alone for the disease spreads too slowly. The combination of the two methods, however, proved helpful.

In 1915 Rorer reported that he had performed inoculation experiments with *Coccobacillus acridiorum* on *Schistocerca paranensis* and *Tropidacris dux* in Trinidad. He found that the organism was pathogenic to both insects and that the virulence could be increased by successive passages. Field experiments were not attempted.

Laines in 1915 reported that he was able to control grasshoppers in Honduras with d'Herelle's organism. A series of grasshoppers was inoculated from the abdominal substance of a series previously dead of the disease. By successive passages in this manner he claims to have obtained a high degree of virulence for the bacterium.

D'Herelle in 1915 controlled a severe outbreak of *Schistocerca peregrina* Oliv. in Tunisia by combining the use of his organism with the mechanical methods.

Velu and Bouin in 1915 reported that d'Herelle's method gave encouraging results in combating *Schistocerca peregrina* in Morocco.

During September, 1915, Dr. L. O. Howard, U. S. Bureau of Entomology, received what was termed two sub-cultures of d'Herelle's Coccobacillus from Dr. Cicilio Lopez Ponce of Honduras. In a letter written by Dr. Ponce the latter says: "Under instructions from the Secretary of the Honduran Commission of Agriculture, who lives in Tegucigalpa, I have the honor of sending you by this post, in a registered package, two tubes of a culture of the *Coccobacillus acridiorum* d'Herrlle. Some time ago I came to this city from the neighboring Republic of Salvador with the object of taking charge of a laboratory devoted to the cultivation and propagation of this parasite, and I am pleased to inform you that the results could not have been more satisfactory."

From their experiments in Canada (1916) Du Porte and Vanderleck concluded that: "The results of our work indicate that d'Herelle's biological method for the control of locusts cannot take the place of the methods now in use under the conditions which obtain in eastern Canada. Should the disease become established, its spread would be extremely slow, owing to the non-migratory and non-cannibalistic habits of the native species. The ideal conditions for the effective use of this method are those such as d'Herelle and others found in South America and North Africa where the locusts were in quickly moving swarms and were markedly cannibalistic in their habits. Indeed, most of these writers have emphasized the fact that "acridiophagy" is the chief factor in the spread of the disease. Another hindrance to the effective use of this method lies in the presence of several native strains of a coccobacillus identical with or closely related to d'Herelle's. These organisms are undoubtedly responsible for the immunity of the locusts to a mild infection of *Coccobacillus acridiorum*."

A perusal of the literature of the subject shows that five out of nine articles report encouraging field results by the use of d'Herelle's *Coccobacillus acridiorum*. These five reports all deal with the genus *Schistocerca* represented by the species *americana*, *paranensis*, and *peregrina*. The unsuccessful reports deal with a variety of grasshopper genera such as *Stauronotus*, *Zonocerus*, *Oedalens*, *Locusta* and *Melanoplus*. The bacterium may be very effective when used against certain species of the genus *Schistocerca*, whereas it may be impossible to establish an epidemic in the field amongst members of certain other genera. All of the workers reported that the bacteria they used were pathogenic in their laboratory experiments. The field failures may be due to differences between the habits of the members of the genus *Schistocerca* and those of other genera. Differences between the climates of the separate countries where *Coccobacillus acridiorum* was used may also account for the varied results. The natural immunity of different genera or species is another factor worthy of consideration. Shall we therefore, owing to several failures, condemn d'Herelle's method under certain conditions? Obviously not.

D'Herelle and other workers who used his organism and methods successfully consider the following requirements the most necessary to the rapid spread of the disease in the field.

1. Cannibalistic habits of the insects (as very frequently exhibited by the genus *Schistocerca*).
2. Migratory habits (exhibited by the genus *Schistocerca*).
3. Dense hopper infestation.
4. Absence in hoppers of bacteria closely related to the *Coccobacillus acridiorum*. The presence of such organisms may have an immunizing effect.
5. Not an overabundance of normal food. When food becomes scarce due to the hopper infestation, the insects acquire cannibalistic habits which are favorable to the spread of the disease.
6. High temperature. The disease spreads more rapidly at the optimum temperature.
7. Absence of excessive rain. A heavy rain paralyzes the march of the epidemic.

All of the foregoing factors are undoubtedly highly important, but the writer should like to add one more requirement absolutely necessary for the study of this subject, namely:

8. The use of the same organism by the different investigators. Carefully controlled cultures should be distributed and used. The cultural and especially the bio-chemical characters of *Coccobacillus acridiorum* should be referred to constantly. Reference to morphological characters solely, as has been done so often, is worthless.

During December, 1915, I received from Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology, two nutrient agar tubes containing pure cultures of a bacterium. These cultures were forwarded to Washington at the request of Dr. Howard by Dr. Cicilio Lopez Ponce, representing the Secretary of the Honduran Agricultural Commission of Tegucigalpa, Honduras.

The cultures were supposed to represent d'Herelle's *Coccobacillus acridiorum* and Dr. Ponce claimed to have obtained striking results with them in his field experiments.

During February, 1917, I received two cultures of the supposed *Coccobacillus acridiorum* direct from Dr. F. d'Herelle who is now at the Pasteur Institute, Paris. One culture was labeled "Souche Cham" which d'Herelle informed me is identical with the one I received from Dr. Ponce of Honduras. The other culture was labeled "Souche Sidi" and according to d'Herelle represented a strain of *Coccobacillus acridiorum* passed through a series of grasshoppers in Tunisia in 1915.

Also in February, 1917, I received through the kindness of Dr. C. Gordon Hewitt a pure culture of the supposed *Coccobacillus acridiorum* from Messrs. Du Porte and Vanderleck, who have performed some interesting experiments with this bacterium in eastern Canada. Dr. Hewitt, in a letter to me, stated that he received this culture direct from the Pasteur Institute in Paris.

I made a careful systematic study of these four cultures, compared them with one another as well as with the published descriptions of d'Herelle, and those of Du Porte and Vanderleck. The cultures differ from one another more or less. A table on page 25 shows the most salient differences and similarities. Since the bacterium sent by Ponce from Honduras seems to be an organism new to bacteriological literature, I have described it as a new species and named it *Bacillus poncei* in honor of Dr. Cicilio Lopez Ponce. I have also redescribed the three other cultures.*

Bacillus poncei is certainly not a Coccobacillus. It is a true bacillus, not in the least pleomorphic, no matter on what media it is grown. In this respect it certainly differs from d'Herelle's description. The latter emphatically states that his organism is highly pleomorphic, all stages between bacilli and cocci being observed in the same pure culture. *Bacillus poncei* produces much acid in milk; *Coccobacillus acridiorum*, according to d'Herelle, strong alkalinity. In so far as the production of ammonia and the fermentation (with gas) of dextrose, levulose and maltose are concerned the two organisms agree. D'Herelle's cultural and bio-chemical descriptions are so meagre that it is difficult to ascertain his exact meaning.

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* The detailed descriptions will be found appended to this article.

Culture "Souche Cham" is highly pleomorphic. Milk is rendered acid, but is not coagulated. D'Herelle's organism should render milk alkaline and coagulate it. In the production of ammonia and in the fermentation (with gas) of dextrose, levulose and maltose, the two organisms agree. As can be seen from the table on page 25 "Souche Cham" differs greatly from *B. poncei*. Strange as it may seem, "Souche Sidi" and "Souche Cham," the two cultures sent by d'Herelle himself differ from one another. "Souche Sidi" is slightly pleomorphic, but this character is not nearly so pronounced as is the case with "Souche Cham." "Souche Sidi" coagulates milk, whereas "Souche Cham" does not. "Souche Sidi" reduces litmus milk; "Souche Cham" does not. "Souche Sidi" does not ferment (with gas) lactose and adonit; "Souche Cham" ferments both of these carbohydrates with the ~~fermentation~~ production of gas (Hydrogen $+CO_2$). "Souche Sidi" does not tally with d'Herelle's description nor with *B. poncei.*

Du Porte and Vanderleck's culture agrees with the culture I received from d'Herelle under the name of "Souche Sidi." Curiously enough, however, my description of Du Porte and Vanderleck's culture does not entirely agree with the description given by these writers. I agree with them in so far as the morphological characters are concerned. My gelatin stabs, however, showed liquifaction after about eight weeks; they claim that gelatin is not liquified. My litmus was reduced; Du Porte and Vanderleck claim "no reduction." I am unable accurately to interpret the results of Du Porte and Vanderleck's carbohydrate fermentation tests for the reason that they do not state whether fermentation was accompanied by the formation of gas and acid or merely acid alone. I assume they mean gas formation, in which case, as will be seen from the table on page 25, our lactose tests differ.

What can one conclude from these results? Only this, namely, that different organisms are being distributed under the name of *Coccobacillus acridiorum*. I should, moreover, like to suggest that d'Herelle redescribe the organism concerned in his grasshopper epidemic more accurately so that other workers may know to which bacterium reference is made. Judging from the morphological descriptions alone I think d'Herelle has reference to the highly pleomorphic organism which he sent me labeled "Souche Cham," but of course, this is merely a conjecture. Du Porte and Vanderleck found several pleomorphic organisms native to grassphopers in eastern Canada.

TABLE SHOWING MOST STRIKING DIFFERENCES AND SIMILARITIES BETWEEN CULTURES DISTRIBUTED UNDER THE NAME COCCOBACILLUS ACRIDIORUM D'HERELLE.

	MORPHOLOGY	GELATIN STAB	MILK	LITMUS MILK	NH_3 on POTATO	NITRATE REDUCTION	INDOL	DEXTROSE	LEVULOSE	SACCHAROSE	MALTOSE	LACTOSE	MANNIT	ADONIT	DULCIT
Bacillus poncei from Honduras	Bacilli	No liquifaction	Strong acidity. Coagulation.	Strong acidity Coagulation Reduction	+	+	O	+	+	O	+	+	+	+	O
"Souche Sidi" from d'Herelle	Bacilli and coccoid forms	Liquifaction	Weak acidity. Coagulation.	Weak acidity Coagulation Reduction	+	+	O	+	+	+	+	O	+	O	O
Culture sent by Du Porte & Vanderleck	Bacilli and coccoid forms	Liquifaction	Weak acidity. Coagulation.	Weak acidity Coagulation Reduction	+	+	O	+	+	+	+	O	+	O	O
"Souche Cham" from d'Herelle	All stages between bacilli and diplococci	Gas. Liquifaction	Weak acidity. No coagulation.	Weak acidity No coagulation No reduction	+	+	O	+	+	+	+	+	+	+	O
d'Herelle's Original Description	All stages between bacilli and cocci	Not mentioned	Strong alkalinity. Coagulation.	Not mentioned	+	Not mention'd	Not mention'd	+	+	Not mention'd	+	Not mention'd	Not mention'd	Not mention'd	Not mention'd
Du Porte & Vanderleck's Description	Bacilli and diplococci	No liquifaction	Acidity. Coagulation.	Weak acidity Coagulation No reduction	Not mention'd	Not mention'd	O	+	Not mention'd	+	Not mention'd	+	Not mention'd	O	O

EXPERIMENTATION WITH CULTURES.

In order to test the pathogenicity of the separate cultures laboratory experiments were performed with *Bacillus poncei* and with d'Herelle's cultures labeled "Souche Cham" and "Souche Sidi." I attempted no experiments with the culture obtained from Messrs. Du Porte and Vanderleck for the reason that my systematic study showed this culture to be identical with d'Herelle's "Souche Sidi" strain.

In all of my experiments the most painstaking bacteriological technicalities were observed, so I shall not undertake to describe all of the tiresome and well known methods in vogue such as using sterile instruments, etc., for injecting and operating upon a grasshopper. Suffice it to say, that sterile containers in the form of battery jars were found extremely useful in performing my experiments. Glass plates covered the jars in order to keep the hoppers from jumping out. These plates had the further advantage of keeping the corn leaves, with which we fed the insects, fresh. Prior to the injection the hoppers were always washed with 95% alcohol. This must not be used too freely, otherwise, the grasshoppers may die and after its use one must wait a minute or so for the alcohol to evaporate before injecting. A small amount of alcohol entering the wound, however minute, caused by the hypodermic needle usually ends fatally. The inoculations were always performed between the metathorax and the first abdominal segment on the ventral side. In order to avoid rupturing the gut or otherwise injuring the insect, two operators are absolutely necessary to perform successful inoculations. One person must carefully, but firmly hold the insect while the other inoculates. I performed a number of tests in order to determine whether my technical precautions were sufficient and I found them satisfactory. For example: I washed off a large series of grasshoppers with alcohol and then injected with sterile water. Some of the insects I permitted to live until they seemed to die of natural causes; others I killed after periods of one and two weeks in order to inoculate culture tubes with some blood obtained by bathing the trochanter and femur with alcohol and then breaking the joint by a swift movement. The culture tubes remained perfectly sterile.

Experiments with Bacillus poncei.

On reviewing the tables which illustrate my experiments with *B. poncei* and the other bacteria investigators in this subject may wonder why I used females more often in preference to males. The reasons are these: Female grasshoppers are much larger than the males and consequently easier to handle. Moreover, they seem to be hardier and withstand the alcohol bath and hypodermic needle much better than the males. Finally, the females naturally live longer which is, of course, a decided advantage in any experiment.

Another inconsistency in my experiments seems evident from the fact that at times I used a smaller or a larger number of animals in one experiment than in another. This was found necessary for the reason that large numbers of female grasshoppers of the desired species, sufficiently mature for experimentation, were sometimes difficult to find in the region where my laboratory experiments were performed.

The tables given on pages 38–41 are self-explanatory. The insects were always inoculated with one drop (1/10 c. c.) of the particular fluid. The emulsion of the six months old agar culture of *B. poncei* given in Table I was prepared by adding 10 c. c. of sterile water to the old culture and shaking the tube vigorously. The emulsions of the intestinal contents of dead animals were prepared by dissecting out the intestines under aseptic conditions and triturating in sterile test tubes containing 5 c. c. of sterile water. This material, owing to the fact that it contained shreds of tissue was filtered in a sterile filter especially prepared for the experiments and from which unfiltered air was excluded.

Tables II, III and IV represent passage infections modeled after the experiments performed by other workers. By an examination of Tables I–IV it would seem that I had increased the virulence of *B. poncei*, while the deaths represented on Tables I and II extend over a long period of time; at the second and especially at the third passage Tables III and IV, the number of days elapsing between infection and death are considerably shortened.

The optimist would at once proclaim this as evidence for increase in virulence, but such is not the case. The three animals dead in the last experiment were carefully examined and an earnest attempt was made to recover *B. poncei*, but I utterly failed. I inoculated a variety of media from the blood, from various tissues and from the intestines. I plated from these media and tested all suspicious looking colonies on the required media, (media given in my descriptions of organism) in the sugar tubes and performed the nitrate and indol tests as well but without success. About a half-dozen other organisms were found, but *B. poncei* failed to reveal itself. What killed the grasshoppers? The five deaths represented on Table I were probably due to *B. poncei*, but the deaths in the three passage infections were due to the careless way in which these experiments were carried out. Since this method has been used by practically all workers on this subject, I wish to point out its absolute worthlessness. Grasshopper intestines, as a large number of observations convinced me, are not only often full of gregarines and flagellates, but contain many species of bacteria (intestinal flora). By performing such passage infections as outlined in my tables one simply inoculates the animals with an indefinite quantity of intestinal flora. No wonder the animals succumbed. What then became of *B. poncei?* This bacterium was either destroyed by the countless other introduced bacteria or was killed by the grasshopper blood cells (phagocytocis) or other immunity principles. If the grasshoppers are to be inoculated in the body cavity why should so many investigators choose the intestines for further passages? Why not perform the passages with the blood? Of course, a sufficient number of the organisms introduced should cling to the outside of the intestines when these are removed, but other organisms within the intestines are likewise introduced. I also failed to obtain pure cultures of *B. poncei* by resort to blood passages on the animals I used (*Melanoplus femur-rubrum* and *Encoptolophus sordidus*) for the reason that the blood seems to act antagonistically towards the bacterium in question and destroys it in most cases. Nevertheless, other organisms are carried along since the toxins or other products introduced cause a disturbance of some sort which in turn causes the gut of the grasshopper to rupture liberating the intestinal flora into the body cavity.

Tables V, VI and VII represent another series of experiments performed along the same lines as the preceding. The results were exactly similar. I know of no way in which passage infections can be performed in this manner. Tables VIII, IX and X represent another series of passages performed on another species of grasshopper, *Encoptolophus sordidus*. Even after the 1st passage I failed to recover *B. poncei*. Strange as it may appear, I recovered *B. poncei* from one animal dead in the 2nd passage.

Table XI represents thirty-five animals (*M. femur-rubrum*) inoculated with a twenty-four hour bouillon culture of *B. poncei*. The organism in question was recovered only three times.

Table XII demonstrates what is meant by the rupture of the gut after a foreign toxin or protein is introduced into the blood. In order to see whether I was rupturing the intestines myself by introducing the hypodermic needle, I injected a large series of grasshoppers with a dead culture of *B. poncei*. After three days I inoculated some bouillon tubes with some of the blood taken from these animals. The tubes remained perfectly sterile.

Tables XIII and XIV represent experiments on infection by feeding. Here the organisms were introduced into the alimentary tract. If *B. poncei* is pathogenic at all, I thought, this would be the most natural method of infection. I failed, however, to recover the organism either from the feces, from the living infected animals, or from the alimentary tract of the dead. From what did these animals die? Possibly from endotoxins liberated from *B. poncei*, which was destroyed within the grasshopper stomach and intestines.

The method of spraying the culture on the food foliage consisted in diluting the culture one-half with sterile water and spraying with a fine atomizer until the leaves were visibly wet.

Conclusions on Experiments with B. poncei.

I conclude from the foregoing experiments that *B. poncei* is pathogenic to *Melanoplus femur-rubrum* and *Encoptolophus sordidus*. In most cases, however, I failed to recover the organism from the blood, the alimentary tract and from the feces. My experiments lead me to believe that insects can develop immunity principles which can more or less successfully cope with certain foreign organisms. The following experiment will further assist in substantiating this view. October 12, 1916, I inoculated six female *M. femur-rubrum* with a twenty-four hour bouillon culture of *B. poncei*. October 13th the animals were all alive. I pulled out one metathoracic leg from each animal and permitted a drop of blood from each to flow into a nutrient bouillon tube. Three tubes were kept at room temperature and three were incubated, yet all six remained perfectly sterile. Stained smears of some of the blood also failed to reveal any micro-organisms. Sooner or later, I think, the gut would have ruptured liberating the intestinal flora into the body cavity, so I thought it best to make the tests the second day.

I further conclude that passage infections performed by using the alimentary tract are hopeless on account of the extensive flora. Blood passages, with *B. poncei*, were likewise useless, in most cases, for the reason that the gut ruptured after a short time. Passages by means of the blood are possible with other bacteria, however, as I will show later.

Experiments with Cultures "Souche Cham" and "Souche Sidi."

The infection experiments with "Souche Cham" and "Souche Sidi" were much more satisfactory than those with *B. poncei*. In regard to "Souche Cham," I successfully performed two passages, but curiously enough, as can be seen from Tables XV–XVII (1 and 2), obtained no increase in virulence. Perhaps if I had measured the time between inoculation and death in hours instead of in days, I might have noticed something, but many deaths unfortunately occurred during the night. However, measurement of time in days is sufficient and if a marked increase in virulence had manifested itself, I surely would have noticed it.

The gut of *M. atlanis* never ruptured, so the blood or muscle tissue could readily be used as a basis for further inoculations. In no case, however, can extracts from the stomach or the intestines be used for further passages. A series of examinations conclusively proved that these are invariably contaminated even in perfectly normal looking animals.

Tables XVIII and XIX represent experiments dealing with food infections. *M. atlanis* was also the subject for these tests. In general the time between infection and death is somewhat extended which is to be expected in this mode of experiment, still it seems to me that the organism acts very quickly. These "per os" infections really mean more than the inoculation experiments for the reason that it is the natural way in which the bacterium would invade the insect. Of course, laboratory passages, where pure recoveries are required, are impossible to perform by this method of infection unless one plated between each infection. Since my experiments showed the futility of passages, in so far as increase in virulence is concerned, I did not see any advantage in doing an extra amount of tedious work. It seems to me that the organism is sufficiently virulent even in old cultures, so that if one could succeed in establishing a center of infection in the field an epidemic would soon follow provided certain conditions were favorable.

Tables XX and XXI also represent food infections. *M. bivittatus* was the subject. If it is permissible to judge from two experiments the organism does not seem to be so pathogenic to this insect. A number of insects in the XX experiment succumbed to parasitism by *Mermis ferruginea*, a nematode.

Table XXII represents the same sort of an experiment as the preceding with the exception that *M. femur-rubrum* was the subject. "Souche Cham" also does not seem to be as highly pathogenic to this species as it is to *M. atlanis*.

Table XXIII represents an inoculation experiment with "Souche Sidi." *M. atlanis* was the subject. The period from infection to death extends over a period of six days. This seems to show that "Souche Sidi" is not as pathogenic as "Souche Cham."

Table XXIV represents a food infection experiment with the same culture and the same subject. The period from infection to death is also, in general, prolonged. Two animals died naturally although I am certain they became infected.

In all of the food infection experiments the grasshoppers were given barely enough leaves in order to insure their eating everything in 12–24 hours.

Table XXV represents a food infection experiment with "Souche Sidi." The subject in this case was *M. bivittatus*. The pathogenicity of "Souche Sidi" for this species seems to be the same as for *M. atlanis*.

Suitable checks accompanied all of my experiments. These always died of old age or of *Mermis* parasitism, but seemed not to suffer naturally from any endemic disease. At times I found some checks prematurely dead, but I traced this to CO_2 asphyxiation and on replacing my glass plates, which covered the battery jar containers, with cheese-cloth tops, I overcame this difficulty. The glass plates are splendid, however, unless one confines too many insects in one jar.

As can be seen on examining the tables, I performed a large series of post mortem tests. This means that stained smears were studied and that the material was "plated out," colonies isolated and the species studied on different media, and their bio-chemical characters in carbohydrates, etc., observed. Of course, some of these final tests were finished long after the conclusion of the grasshopper season. It is absolutely impossible to perform in a short time, the huge amount of work which experiments of this sort require.

Conclusions on experiments with cultures "Souche Cham" and "Souche Sidi."

1. "Souche Cham" is pathogenic to *M. atlanis*, *M. bivittatus* and *M. femur-rubrum.*

2. "Souche Cham" is not as pathogenic to *M. bivittatus* and *M. femur-rubrum* as to *M. atlanis.*

3. Passage infections with "Souche Cham" were possible, but no increase in virulence was observed.

4. The gut of *M. atlanis* does not rupture, and for this reason the blood and muscle tissue can be used for passage infections.

5. Extracts from the stomach or intestines can not be used for passage infections.

6. In food infections the time between inoculation and death is somewhat extended.

7. "Souche Cham" and "Souche Sidi" are quite virulent even in old cultures.

8. "Souche Sidi" is not as pathogenic to *M. atlanis* and *M. bivittatus* as "Souche Cham."

9. No passage infections with "Souche Sidi" were attempted.

FIELD EXPERIMENTS.

Melanoplus atlanis is a serious pest in certain regions of the State of Vermont. Since this species occurs in dense swarms and since it acquires cannibalistic habits when natural food becomes scarce, I thought it would be splendid material for field work. Mr. A. M. Wilcox and I have instituted a large series of field experiments with cultures "Souche Cham" and "Souche Sidi" in Vermont, but we wish to await the passage of at least another season before drawing any conclusions. The hurried method of rushing into print field observations dealing with a single season's work is deplorable. The amount of work which is necessary before coming to any conclusions at all is so immense that an army of trained workers co-operating in every possible way could not obtain final results after a single season's work.

Culture sent by Dr. Cicilio Lopez Ponce of Honduras under the name of *Coccobacillus acridiorum:*

Bacillus poncei sp. nov.

Morphology. From 1½% nutrient agar stroke 24 hours old, long rods. From 1½% potato agar stroke 24 hours old, long rods and some short rods. From milk 48 hours old, many short rods. Average length 2.2μ. Average width .9μ. Motile. Gram negative. Stains readily.

Nutrient agar stroke. 1½%. Neutral. Growth moderate, spreading, flat, glistening, smooth, white, opaque, odor absent, butyrous, medium unchanged.

Potato agar stroke. 1½%. Neutral. Growth very luxuriant, arborescent, flat, glistening, smooth, white, opaque, odor absent, butyrous, medium unchanged.

Potato. Growth abundant, spreading, flat, glistening, smooth, white, odor absent, butyrous, medium unchanged.

Gelatin stab. Growth best at top, beaded, no liquifaction, medium unchanged.

Nutrient broth. Neutral. Pellicle, clouding strong, no clearing after 15 days, odor absent, slight sediment.

Milk. Acid. Coagulation in six days. Extrusion of whey in six to ten days, no peptonization, color of medium unchanged.

Litmus milk. Acid, coagulation, prompt reduction.

Gelatin colonies. Growth slow, white, round, slightly raised, edge entire, no liquifaction.

Agar colonies. Growth slow, white, round, smooth, raised slightly, edge entire, amorphous, diameter 4 mm.

Ammonia production. Feeble.

Nitrate solution. Nitrates reduced to nitrites.

Indol production. Absent.

Hydrogen sulphide production. Absent.

Fermentation of carbohydrates with gas.

Dextrose	+	Lactose	+
Levulose	+	Mannit	+
Saccharose	O	Adonit	+
Maltose	+	Dulcit	O

Pathogenicity. Pathogenic to *Melanoplus femur-rubrum*, *Encoptolophus sordidus*, and *Gryllus pennsylvanicus*. Pathogenicity not tested out on any other forms.

Culture sent by d'Herelle under the name *Coccobacillus acridiorum*. Culture labeled "Souche Cham":

Morphology. From 1½% nutrient agar stroke 48 hours old, small diplococci. All very uniform. No bacilli. In water of condensation all transition forms between diplococci and bacilli. Highly polymorphous.* From milk 48 hours old, small diplococci, no bacilli. From bouillon 48 hours old, all intermediate stages between true bacilli and coccus forms. Nutrient bouillon is a favorable medium for the development of the bacillus forms. Solid media like nutrient and potato agar are favorable for the development of the diplococcus forms. This can be easily demonstrated by transferring from the liquid to the solid medium and vice versa. Diameter of cocci .6μ. Length of bacilli .7-1.5μ. Motile. Gram negative. Stains readily.

Nutrient agar stroke. 1½%. Neutral. Growth abundant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, color of medium unchanged.

Potato agar stroke. 1½%. Neutral. Growth very luxuriant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, color of medium unchanged.

Potato. Growth abundant, whitish.

Gelatin stab. Growth uniform, beaded, gas, liquifaction, medium unchanged.

Nutrient broth. Ring, slight pellicle, clouding strong, sediment abundant, odor absent, no clearing after fifteen days.

Milk. Weak acidity, no coagulation, color of medium unchanged.

Litmus milk. Weak acidity, no coagulation, no reduction.

Gelatin colonies. Growth rapid, round, convex, edge entire, gas, diameter of colony .5-1 mm.

Nutrient agar colonies. Growth rapid, round, smooth, flat, edge entire, amorphous, diameter of colony 2.5-3 mm.

Ammonia production. Positive.

Nitrate solution. Nitrates reduced to nitrites.

Indol production. Negative.

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*For an interesting article on pleomorphism see: Studies in pleomorphism in Typhus and other diseases by Edward C. Hort. Abstract in Jour. Royal Micros. Soc., December, 1916.

Hydrogen sulphide production. Negative.

Fermentation of carbohydrates with gas.

Dextrose	+	Lactose	+
Levulose	+	Mannit	+
Saccharose	+	Adonit	+
Maltose	+	Dulcit	O

Pathogenicity. Pathogenic to *Melanoplus atlanis*, *Melanoplus bivittatus*, and *Melanoplus femur-rubrum.* Pathogenicity not tested out on any other forms.

Culture sent by d'Herelle under the name *Coccobacillus acridiorum.* Culture labeled "Souche Sidi":

Morphology. From 1½% nutrient agar stroke 48 hours old, short bacilli dominant forms; some coccoid forms. In water of condensation bacillus forms typical. From milk 48 hours old, bacillus forms dominant; some coccoid forms. From bouillon 48 hours old, typical bacillus forms dominant; few coccoid forms. Not as polymorphous as culture "Souche Cham." Length of bacilli .8-1.5μ. Motile. Gram negative. Stains readily.

Nutrient agar stroke. 1½%. Neutral. Growth abundant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, color of medium unchanged.

Potato agar stroke. 1½%. Neutral. Growth very luxuriant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, color of medium unchanged.

Potato. Growth abundant, whitish.

Gelatin stab. Growth uniform, beaded, liquifaction, medium unchanged.

Nutrient broth. Ring, slight pellicle, clouding strong, sediment abundant, odor absent, no clearing after fifteen days.

Milk. Weak acidity, coagulation delayed, extrusion of whey, no peptonization, color of medium unchanged.

Litmus milk. Weak acidity, coagulation, extrusion of whey, reduction complete.

Gelatin colonies. Growth rapid, round, convex, edge entire, no liquifaction, diameter of colony .5-1 mm.

Nutrient agar colonies. Growth rapid, round, smooth, flat, edge entire, coarsely granular, diameter of colony 2.5-3 mm.

Ammonia production. Positive.

Nitrate solution. Nitrates reduced to nitrites.

Indol production. Negative.

Hydrogen sulphide production. Negative.

Fermentation of carbohydrates with gas.

Dextrose	+	Lactose	O
Levulose	+	Mannit	+
Saccharose	+	Adonit	O
Maltose	+	Dulcit	O

Pathogenicity. Pathogenic to *Melanoplus atlanis* and *Melanoplus bivittatus.* Pathogenicity not tested out on any other forms.

Culture sent by Messrs. Du Porte and Vanderleck of Canada, who received same from d'Herelle under the name of *Coccobacillus acridiorum:*

Morphology. From 1½% nutrient agar stroke 48 hours old, short bacilli dominant forms; some coccoid forms. In water of condensation bacillus forms typical. From milk 48 hours old, bacillus forms dominant; some coccoid forms. From bouillon 48 hours old, typical bacillus forms abundant; few coccoid forms. Not as polymorphus as culture "Souche Cham." Length of bacilli .8-1.5μ. Motile. Gram negative. Stains readily.

Nutrient agar stroke. 1½%. Neutral. Growth abundant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, medium unchanged.

Potato agar stroke. 1½%. Neutral. Growth very luxuriant, spreading, flat, glistening, smooth, opaque, odor absent, butyrous, medium unchanged.

Potato. Growth abundant, whitish.

Gelatin stab. Growth uniform, beaded, liquifaction, medium unchanged.

Nutrient broth. Ring, slight pellicle, clouding strong, sediment abundant, odor absent, no clearing after fifteen days.

Milk. Weak acidity, coagulation delayed, extrusion of whey, no peptonization, color of medium unchanged.

Litmus milk. Weak acidity, coagulation, extrusion of whey, reduction complete.

Gelatin colonies. Growth rapid, round, convex, edge entire, no liquifaction, diameter of colony .5-1 mm.

Nutrient agar colonies. Growth rapid, round, smooth, flat, edge entire, coarsely granular, diameter of colony 2.5-3 mm.

Ammonia production. Positive.

Nitrate solution. Nitrates reduced to nitrites.

Indol production. Negative.

Hydrogen sulphide production. Negative.

Fermentation of carbohydrates with gas.

Dextrose	+	Lactose	O
Levulose	+	Mannit	+
Saccharose	+	Dulcit	O
Maltose	+	Adonit	O

Pathogenicity. Pathogenic to *Melanoplus atlanis* and *Melanoplus bivittatus.* Pathogenicity not tested out on any other forms.

Original description by d'Herelle of *Coccobacillus acridiorum:*

Morphology. Media from which the morphological observations were made not mentioned. Short bacillus, slightly oval, very polymorphous. Cocci .6μ, bacilli .4-.6μ by .9-1.5μ. Motile, peripheral flagellæ. Gram negative, stains readily.

Potato. Growth creamy. Water of condensation sirupy, reaction strongly alkaline.

Gelatin. Not liquified.

Nutrient broth. Development rapid at 37°. Clouding from fourth hour on. After several days a very light veil appears. Bouillon clears after three weeks, producing a sediment. A young culture agitated produces silky waves. Odor of Liebig's extract. Rendered strongly alkaline.

Milk. Coagulated and rendered strongly alkaline.

Nutrient agar colonies. Visible after 12 hours. After 18 hours they are 2–3 mm. in diameter. Circular, waxy. Below surface spherical, whitish, opaque.

Fermentation of carbohydrates.

Dextrose	+	Organism renders medium containing one of these sugars slightly acid ~~than~~ then alkaline.
Levulose	+	
Maltose	+	
Galactose	+	

Oxygen requirements. Facultative anaerobe.

Pathogenicity. Pathogenic to various Acrididæ, ants and caterpillars.

Description by Du Porte and Vanderleck of culture sent to them from d'Herelle under the name *Coccobacillus acridiorum:*

Morphology. From agar slope 20 hours old, short rods or cocci, some oval, polymorphous. 0.7–1.0μ. In milk culture they appear often as diplococci. Motile. Gram negative. Amylgram positive. Stain readily.

Agar stroke. Abundant growth, spreading, flat, glistening, smooth, dirty white to bluish white, opaque, butyrous, medium unchanged. On 1% agar the cultures are arborescent and transparent.

Potato. Abundant growth, spreading, flat, glistening, smooth, butyrous; color from dirty white to yellow.

Gelatin stab. Uniform growth, line of puncture filiform. No liquifaction, medium unchanged. Stab brownish yellow.

Nutrient broth. Pellicle or ring, turbidity, slight sediment, no clearing after 14 days, odor of beef extract.

Milk. At first gas production without coagulation. Delayed coagulation in 2–8 days, acid reaction after 8 days, no peptonization, medium unchanged, no extrusion of whey.

Litmus milk. Gas production, weak acidity, no reduction. After four days partial to complete coagulation, acid.

Gelatin colonies. Growth slow, round, raised, edge entire, yellow. Three weeks, 2 mm. in diameter, yellow white. No liquifaction.

Agar colonies. Rapid growth, irregular, round, smooth, flat, edge entire, amorphous, dirty white to blue, transparent. Growth more restricted on 1½% than on 1% agar.

Aesculin bilesalt agar. Weak field after 24 to 48 hours.

Neutral red bilesalt agar. Strong fluorescence, red spreading.

Indol production. Negative.

Fermentation of carbohydrates.

Dextrose	+	Rafinose	+
Saccharose	+	Arabinose	+
Lactose	+ (weak)	Adonit	O
Galactose	+	Dulcit	O
Muscle sugar	+		

Pathogenicity. Pathogenic to locusts and grasshoppers. Injection fatal within 24 hours.

TABLE I.

Ten animals injected with an emulsion of a 6 months old agar culture of *B. poncei.* ♀ ♀ *M. femur-rubrum* used.

No. of days....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
No. of deaths..		1			1			1					1	1	5 lived

TABLE II.

Eight animals injected with an emulsion of intestinal contents of animal dead on 8th day. ♀ ♀ *M. femur-rubrum* used. 1st passage.

No. of days.........	1	2	3	4	5	6	7	8	9	10	
No. of deaths.......		1				2	1	2		1	1 lived

TABLE III.

Three animals injected with an emulsion of intestinal contents of an animal dead on the 6th day. ♀ ♀ *M. femur-rubrum* used. 2nd passage.

No. of days..................	1	2	3	4	5
No. of deaths................			1	1	1

TABLE IV.

Three animals injected with an emulsion of intestinal contents of last one dead in previous experiment. ♀ ♀ *M. femur-rubrum* used. 3rd passage.

No. of days........................	1	2	3	4
No. of deaths......................		3		

The three animals dead on 2nd day were "tested." *B. poncei* not recovered. Other organisms recovered.

TABLE V.

Eight animals injected with a 24-hour culture of *B. poncei* in nitrate solution. ♀ ♀ *M. femur-rubrum* used.

No. of days......	1	2	3	4	5	
No. of deaths....			2		2	4 lived for a month

TABLE VI.

Three animals injected with an emulsion of intestinal contents of last two dead in previous experiment. ♀ ♀ *M. femur-rubrum* used. 1st passage.

No. of days........................	1	2	3	4
No. of deaths......................		2	1	

Table VII.

Three animals injected with an emulsion of intestinal contents of last one dead in previous experiment. ♀ ♀ *M. femur- rubrum* used. 2nd passage.

No. of days	1	2	3	4
No. of deaths		3		

Three animals dead in last experiment "tested." *B. poncei* not recovered. Other organisms recovered.

Table VIII.

Five animals injected with a 24-hour culture of *B. poncei* in nitrate solution. ♀ ♀ *Encoptolophus sordidus* used.

No. of days	1	2	3	4	5	6	
No. of deaths		2	1			1	1 lived

Table IX.

Five animals injected with an emulsion of intestinal contents of last one dead in previous experiment. ♀ ♀ *Encoptolophus sordidus* used. 1st passage.

No. of days	1	2	3	4	5	6	7	
No. of deaths			1			1	1	2 lived

Animals dead on 6th and 7th days "tested." *B. poncei not* recovered. Other organisms recovered.

Table X.

Five animals injected with an emulsion of intestinal contents of last one dead in previous experiment. ♀ ♀ *Encoptolophus sordidus* used. 2nd passage.

No. of days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
No. of deaths								1		1		1					1		1

Animals dead on 12th, 17th and 19th days "tested." *B. poncei* recovered from animal dead on 12th day. Other organisms recovered from remaining two tests.

Table XI.

Thirty-five animals injected with a 24-hour bouillon culture of *B. poncei*. ♀ ♀ *M. femur-rubrum* used.

No. of days	1	2	3	4	5	6	7	8	9	10	11
No. of deaths		9	7	12	4	2					1

Three dead animals "tested" on 4th day as well as last seven dead. Recovered *B. poncei* three times. Other organisms recovered in remaining tests.

Table XII.

Nineteen animals injected with a 24-hour bouillon culture killed by sterilizing in autoclave. Sterility verified by inoculating various media. ♀ ♀ *M. femur-rubrum* used.

No. of days	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of deaths		2		3			9	1	1	1	1			1

Six animals "tested." *B. poncei* not recovered. Two tests showed cultural sterility; four showed presence of other organisms.

Table XIII.

Nine animals enclosed in a battery jar and food sprayed with a 48-hour culture of *B. poncei*. Proportions of sexes not noted, but ♂ ♂ and ♀ ♀ of *M. femur-rubrum* used.

No. of days	1	2	3	4	5	6	7	8	0	10
No. of deaths						2	2			5

Five dead animals "tested." *B. poncei* not recovered. Other organisms recovered.

Table XIV.

Eight animals enclosed in a battery jar and food sprayed with a 48-hour culture of *B. poncei* in nitrate solution. Four ♂ ♂ and four ♀ ♀ *M. femur-rubrum* used.

No. of days.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. of deaths...					1		2	1		1		1					1			1

Three dead animals "tested." *B. poncei* not recovered. Other organisms recovered.

Table XV.

Twenty animals injected with a 17-hour bouillon culture of *Coccobacillus acridiorum* "Souche Cham." ♀ ♀ *M. atlanis* used.

No. of days........................	1	2	3	4
No. of deaths........................		17	3	

Last three dead "tested." Piece of femural muscle removed aseptically and dropped into culture tube. Pure culture of "Souche Cham" obtained.

Table XVI.

Two out of seventeen dead on 2nd day in previous experiment taken and femural muscle triturated in 10 c. c. sterile H_2O. Eight ♀ ♀ *M. atlanis* injected. 1st passage.

No. of days....	1	2	3	4	5	6	7	8
No. of deaths..		5	3					

Tests made from blood and femural muscle of dead animals reacted positively for "Souche Cham." No other organisms found.

Table XVII (No. 1 and 2).*

Eight animals injected from one dead on 3rd day in previous experiment and eight injected from another dead the same day. Femural muscle triturated as above. ♀ ♀ *M. atlanis* used. 2nd passage.

No. 1.

No. of days..................	1	2	3	4	5
No. of deaths...............		5	3		

No. 2.

No. of days..................	1	2	3	4	5
No. of deaths...............		4	4		

Last three dead in No. 1 and two dead from No. 2 examined. "Souche Cham" recovered. No other organisms found.

Table XVIII.

Ten animals infected by spraying corn leaves with 24-hour bouillon culture of "Souche Cham." Five ♂ ♂ and five ♀ ♀ *M. atlanis* used.

No. of days...........	1	2	3	4	5	6
No. of deaths.........		4	1	4	1	

Three of dead animals "tested." "Souche Cham" recovered from feces and from alimentary tract. Two other organisms recovered.

Table XIX.

Eight animals infected by spraying corn leaves with 24-hour bouillon culture of "Souche Cham." Four ♂ ♂ and four ♀ ♀ *M. atlanis* used.

No. of days........................	1	2	3	4
No. of deaths........................		2	6	

Three animals "tested." "Souche Cham" recovered from alimentary tract. One other organism recovered.

---

*Signifies separate jars in which grasshoppers were kept, so really two separate experiments, otherwise I might have incorporated the two experiments in one table.

Table XX.

Nineteen animals infected by spraying corn leaves with 24-hour bouillon culture of "Souche Cham." *M. bivittatus* used. Proportion of sexes not noted.

No. of days....	1	2	3	4	5	6	7	
No. of deaths..		3	2	2	2	4	3	Rest died of worm parasitism
		worm parasitism					worm parasitism	

Two dead on 3rd day "tested." "Souche Cham" recovered from alimentary tract. Other organisms recovered.

Table XXI.

Eight animals infected by spraying corn leaves with a 24-hour bouillon culture of "Souche Cham." Four ♂ ♂ and four ♀ ♀ *M. bivittatus* used.

No. of days...........	1	2	3	4	5	6	
No. of deaths.........				4	1	2	1 lived

One dead on 5th day "tested." "Souche Cham" recovered in pure culture from alimentary tract.

Table XXII.

Eight animals infected by spraying corn leaves with a 24-hour bouillon culture of "Souche Cham." Four ♂ ♂ and four ♀ ♀ *M. femur-rubrum* used.

No. of days....	1	2	3	4	5	6	7
No. of deaths..				4	2	1	1

Two dead on 5th day "tested." "Souche Cham" recovered from alimentary tract. Other organisms recovered.

Table XXIII.

Ten animals injected with a 24-hour culture of "Souche Sidi." ♀ ♀ *M. atlanis* used.

No. of days....	1	2	3	4	5	6	7
No. of deaths..		1	2	3	2	2	

Two animals dead on 5th day "tested." "Souche Sidi" recovered from blood in pure culture.

Table XXIV.

Ten animals infected by spraying corn leaves with a 24-hour culture of "Souche Sidi." Five ♂ ♂ and five ♀ ♀ *M. atlanis* used.

No. of days....	1	2	3	4	5	6	7	
No. of deaths..		2	1	1	2	1	1	2 lived for 10 days and then died naturally after depositing eggs.
		worm parasitism						

Two dead animals "tested." "Souche Sidi" recovered from alimentary tract. Other organisms recovered.

Table XXV.

Eight animals infected by spraying corn leaves with a 24-hour bouillon culture of "Souche Sidi." *M. bivitattus* used. Sexes not noted, but majority females.

No. of days......	1	2	3	4	5	
No. of deaths....			4	1	1	2 lived for about 10 days and then died after depositing eggs

One animal dead on 4th day "tested." "Souche Sidi" recovered from alimentary tract. Other organisms recovered.

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PARASITIC HYMENOPTERA FROM THE BRITISH SOLOMON ISLANDS COLLECTED BY DR. W. M. MANN.

By Charles T. Brues.

With One Plate.

CAMBRIDGE, MASS., U. S. A.:
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REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUTENANT COMMANDER L. M. GARRETT, U. S. N., COMMANDING, PUBLISHED OR IN PREPARATION: —

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By Charles T. Brues.

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No. 3.—*Parasitic Hymenoptera from the British Solomon Islands collected by Dr. W. M. Mann.*

By Charles T. Brues.

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION, HARVARD UNIVERSITY, NO. 141.

Until a few years ago the Hymenoptera of the Solomon Islands remained practically unknown. In 1909, Mr. W. W. Froggatt secured a small collection on the islands and these have been studied by several workers. The parasitic forms were examined by Cameron (Proc. Linn. soc. N. S. W., 1911, **36**, p. 349–365), who found seventeen species, all of which he described as new. At least one of these (*Echthromorpha pallidilineata*) had been previously recorded under another name from the Pelew Islands. In the collection obtained by Dr. Mann there are 32 species which I have been able to study satisfactorily. Six of these are identical with ones described by Cameron from the Solomons; two are forms occurring in New Guinea; one was described years ago by Westwood from the Solomons, and two are rather widespread Indo-Malayan species.

Many of the genera are world-wide; several range through India and the Malay region. One, Lissopimpla, is Australian, although it extends to Ceylon, and *L. erythropus* is therefore an Australian type, even if it be not specifically identical with *L. scutata* Krieg. from Queensland as has been suggested by Morley.

Among the bees of the Solomons, Cockerell (Proc. Linn. soc. N. S. W., 1911, **36**, p. 160) has pointed out general Indo-Malayan affinities with "a genuine Australian element" and this is equally true of the parasitic Hymenoptera, so far as the material and published records go. It may be of interest to note that *Meroglossa tetraxantha* Ckll., a bee mentioned by Cockerell as belonging to a typically Australian genus was also taken by Mann, who secured a single specimen on the island of Yandina, showing that the species is probably a common one in the Solomons.

I have attempted to gather together a list of the parasitic Hymenoptera so far reported from the Solomon Islands and their neighbors as far as the Bismarck Archipelago on the northwest and New Caledonia on the southeast. It is evident that the grouping of these islands with the omission of New Guinea is to a great extent one of convenience only. Many more Papuan species will undoubtedly be found in the Solomons and the meagre list from all the small islands will unquestionably be greatly augmented by intensive collecting. However, the mere fact that Mann obtained over one third of the species previously collected by Froggatt would seem to indicate that the fauna may not be so very extensive.

STEPHANIDAE

STEPHANUS FROGGATTII Cameron.

Megischus frogattii Cameron, Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 357.

There are six specimens including four females and two males from Auki, Malaita; Tulagi; Fulakora; and Malaili. The larger females from Auki are 26–31 mm. in length and have the accessory femoral teeth better developed than the smaller ones (21–23 mm.). The males measure 20–21 mm.

PARASTEPHANELLUS ORBITALIS, sp. nov.

Type.— M. C. Z., 9,051, and *Paratype*. Solomons: Fulakora. W. M. Mann.

♂. Length 7–8 mm. Black, head pale yellowish from mandibles to just above antennae, the inner orbits narrowly pale to the level of the lower tubercle; posterior orbits, wider above, white; antennae piceous, with the base of the flagellum fuscous; palpi piceous; propleurae rufous below; front legs brownish yellow in front; knees and tips of tibiae of all legs whitish, their tarsi honey-yellow. Wings slightly infuscated. Head rugose, transversely so on front below and on vertex medially; three lower tubercles of vertex about equally developed; intra-ocellar ones much weaker; cheeks smooth, malar space as long as first flagellar joint, not furrowed; hind margin of head carinate, but the carina not strongly developed nor recurved. Third and fourth joints of flagellum of antennae the longest, subequal; second twice as long as first, these two together as long as the third. Pronotum in front transversely wrinkled, the wrinkles extending obliquely on the pleurae; on each side with a coarsely punctate area before the smooth posterior margin. Mesonotum with a median punctate line, the parapsidal furrows forming a semicircle; otherwise sparsely foveate-punctate. Axillae rugose, more finely so laterally, separated basally by a small fovea and from the scutellum by straight oblique, foveate furrows; scutellum smooth along its centre; with coarse, sparse punctures laterally. Propodeum with a few very large irregularly placed shallow punctures, with a smooth longitudinal impression on each side extending to the base of the hind coxa and below this with a coarsely reticulate ridge; its sides below the ridge irregularly wrinkled, nearly smooth. Mesopleurae pubescent in front, smooth and shining behind; obliquely raised at the middle and depressed behind towards the propodeum. Abdominal petiole two thirds as long as the thorax, transversely striate above, irregularly rugose on the sides and below; with some stiff white hairs laterally, the spiracles at the middle. Remainder of abdomen polished. Claspers short, no longer than broad with the apex regularly rounded and beset with a short dense fringe of hairs; smooth basally, punctate and hairy on apical half. Hind coxae transversely striate, with an elongate smooth area externally near the base; femora with a prominent tooth at basal third, middle and apical third; two blunt denticles follow after the basal tooth, several acute ones after the middle tooth and a decreasing series of five after the apical tooth. Stigma rather broad, half the width of the radial cell which is complete except at extreme apex; cubital vein distinct almost to wing tip; transverse median vein inserted one third of its length before the basal vein, so that the petiole of the discoidal cell is very short; second discoidal cell open below, but with the basal and apical sides complete, the vein forming the apical side swollen below the tip.

This is a typical member of the genus and apparently distinct from its congeners, all of which occur in the Indo-Malayan region. In all the genera of this undoubtedly old family the structural characters, particularly of body proportions and sculpture, appear to be very firmly fixed and to show scarcely any variation. I append a key, based mainly on color, which will serve to distinguish the present species from the others.

1. Abdomen and most of body yellowish brown small species 5–8 mm. *P. pygmaeus* Enderl.
   Abdomen, beyond base of second segment, black..............2.
2. Abdomen entirely black....................................3.
   Abdomen, black, the petiole reddish.......................6.
3. Head black, orbits white or buff............*P. orbitalis,* sp. nov.
   Head red or red and black, sometimes varied with yellowish...4.

4. Head entirely reddish. . . . . *P. martini* Stadlm.
   Head distinctly maculate or varied in color. . . . . 5.
5. Wings hyaline, scutellum with foveae at base. . *P. malayanus* Cam.
   Wings smoky, no foveae at base of scutellum. *P. maculifrons* Cam.
6. Legs reddish, head rufopiceous. . . . . *P. damellicus* Westw.
   Hind femora and tibiae black; head pale yellowish, blackened above. . . . . *P. brevistigma* Enderl.

DIASTEPHANUS SALOMONIS Westwood.

Thesaur. entom. Oxon., 1874, p. 128 (*Stephanus*).

A female from Wai-ai most surely belongs to this species which was briefly described by Westwood from an imperfect example. I have appended a description including the details omitted in the original description.

♀. Length 17 mm. Black with the apical half of the hind femur and constricted part of the hind tibia ferruginous; head with a broad white band extending from the base of the mandible behind the eye nearly to the top of the eye; front with the inner orbits and a median line extending half way to the median ocellus pale yellow; mandibles ferruginous at middle. Face transversely striate below the tubercles; irregularly reticulate between the tubercles; between the ocelli with two transverse carinae; behind them with wavy transverse aciculations and a median groove. Second and third joints of flagellum equal, each nearly twice as long as the first which is considerably longer than the pedicel. Cheeks smooth and shining. Prothorax very long, equalling the length of the fore leg from the base of the coxa to the knee, its constricted portion finely transversely wrinkled; its posterior margin smooth, preceded by a band of transversely elongated punctures; mesonotum in front irregularly rugose reticulate, smooth behind except for the crenate parapsidal furrows. Propodeum above with coarse thimble-like punctation. Propleurae finely shagreened; mesopleurae smooth above and below, between and in front with a band of large incompletely impressed punctures. Metapleura reticulate above, below with some incomplete vertical wrinkles. Abdominal petiole as long as the head and thorax, transversely striate above and below except at extreme base; hind coxae similarly striated. Hind femur with serrate projections before the middle where it bears a large tooth, behind this with three denticles, another large tooth, then a decreasing series of eight denticles. Ovipositor as long as the body, its sheaths entirely black. Wing-venation typical for the genus, the upper and outer edges of the discoidal cell indicated by slight brown streaks.

Considering the size 17 mm., the locality [1] and the agreement so far as Westwood's description goes, I think this is undoubtedly his species. It is not, however, the same as Schletterer's *Stephanus pallescens* from the Philippines which its author suggested might be Westwood's species. Westwood gives 10½ lines as the alar expanse which is about right for a species 17 mm. in length, but not for one 11 mm. in length, the size given for *S. pallescens* although species of this group sometimes vary considerably in size. The present form differs conspicuously from *S. pallescens* in the form of the antennal flagellum and pedicel.

EVANIIDAE.

TRIGONOFOENUS SALOMONIS, sp. nov.

Type.—M. C. Z. 9,052. Solomons: Malaita, Auki. W. M. Mann.

♀. Length 16 mm., ovipositor 20 mm. Black, with deeply infuscated wings; four anterior femora, tibiae, metatarsi, and second joint of trochanters, ferruginous; first joint of these trochanters, second joint of hind ones and hind tibiae fuscous, base of hind tibia yellowish; hind tarsi orange-yellow at base shading to almost white at tip. Face minutely, confluently punctate; front minutely, somewhat transversely aciculate; ocelli large, the lateral ones about their own diameter from the eye, malar space well developed, as long as the width of the mandible at base, clypeus with the lateral angles slightly prominent, medially broadly emarginate; cheeks and temples very finely and closely punctate; vertex like the front; occipital margin rather sharp and slightly recurved. Third joint of antennae no longer than the second; fourth over three times as long as second and nearly five times as long as thick; following gradually decreasing in length. Prothorax short, not so long as the distance from humerus to tegula. Thorax short, the mesonotum as broad as long; parapsidal furrows oblique, nearly straight, meeting at posterior fourth of mesonotum and from thence prolonged to the scutellum as a median groove; median lobe transversely rugose, more coarsely so on the sides; lateral lobes and scutellum finely rugose. Propodeum deeply reticulate, the spaces rather regular, nearly circular; entire thorax almost without pubescence. Pleuræ coarsely rugose-reticulate, finer on the mesopleura above near the tegulae and on the base of the sides of propodeum. Abdomen subshining, uniformly blackish; sheaths of ovipositor tipped with white. Legs with the hind coxae coarsely transversely rugose above and externally, finely punctate below; hind tibiae less swollen than usual, but little thicker than the femora; their tarsi stout, the first joint distinctly longer than the following together, both the hind tarsi and their tibiae at tip conspicuously clothed with golden pubescence. Radial cell broad, the radius sharply bent upwards at its apical third; small discoidal cell almost as long as its petiole.

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[1] Westwood gives "Solomon's Island (New Hebrides)."

Of the species referred to this genus by Kieffer, this comes closest to *T. abuensis* Cam. from India, from which it differs in its clear wings and differently colored legs. It is also quite different from any species of Gasteruption known from this region, aside from the generic differences which do not appear to be very clear-cut, at least when applied to our American species.

BRACONIDAE.

SPATHIUS MANNI, sp. nov.

Type.—M. C. Z. 9,053. Solomons: Wai-ai. W. M. Mann.

♀. Length 7.5 mm., ovipositor 3 mm. Black; head below the level of the antennae dark reddish brown; antennae yellowish at base, brown beyond: palpi piceous; tarsi brownish yellow; posttegulae white, seventh and eighth segments of abdomen yellow; wings fuscous, with a hyaline cross-band near the base and a hyaline streak extending across from the base of the stigma; apex hyaline; veins black, stigma white at base. Head seen from above, as wide as thick, full behind the eyes, then roundly narrowed to the prominent posterior carina; eyes rather large, as wide as the cheeks, the malar space two thirds the length of the third antennal joint; eyes slightly emarginate opposite the antennae; ocelli in a nearly equilateral triangle, posterior ones nearer to one another than to the eye-margin. Mouth opening gently concave above, the clypeus separated, with deep lateral foveae. Face transversely rugose; front and vertex evenly transversely aciculate; back of head above middle of eyes horizontally aciculate, the aciculations curving upwards to meet those of the vertex; cheeks smooth. Antennae slightly longer than the body, flagellar joints regularly decreasing in length; first one fourth longer than the second; maxillary palpi nearly twice the length of the head. Prothorax with the posterior margin strongly carinate. Thorax long and narrow; mesonotum slightly longer than the propodeum and one half longer than wide, its surface shagreened; parapsidal furrows deep; coalescing at the middle to form a transversely areolate depression. Scutellum with six small elongate pits at the base, its surface shagreened. Propodeum transversely rugose-reticulate; with a median carina that forks just before the middle to form a long petiolar area extending to beyond the middle; spiracle small, circular; below it a complete carina with an incomplete one below that. Pro- and mesopleura irregularly striate and reticulate, the mesopleura with a shagreened area at the middle below. Petiole of abdomen as long as the thorax from posterior angle of propleura to tip of propodeum; slender, scarcely bent, slightly widened at the spiracles and again after posterior fourth, the apex twice as wide as at spiracles which are at basal third; its surface rugose medially, striate-reticulate on the sides, more finely striate toward apex. Second segment microscopically transversely aciculate, more distinctly so at base, as long as wide at apex which is twice as wide as base; third to fifth minutely roughened with a polished band at base; sixth polished; seventh longitudinally striate on basal half. Legs comparatively slender; hind coxae finely shagreened above, their femora four times as long as thick. Front tibiae finely spinulose on their anterior surface; middle ones minutely denticulate; hind ones minutely tuberculate on hind edge. Submedian cell slightly longer than the median, recurrent nervure received at base of second cubital cell; subdiscoidal vein interstitial.

This species is quite distinct in size and color from any others known from the Indo-Malayan region.

Spathius melleus, sp. nov.

Type.—M. C. Z. 9,054. Solomons: Rio. W. M. Mann.

♀. Length 2.7 mm.; ovipositor 1 mm. Honey-yellow, the thorax somewhat darker than the head, abdomen, and legs; antennae blackened beyond middle; wings yellowish hyaline, with a faint cloud just before and another just beyond the middle. Head as broad as thick, scarcely widened behind the eyes, hind margin strongly carinate.

Eyes a little longer than wide, slightly broader than the cheeks. Anterior margin of clypeus strongly concave; face shining, with rather faint irregular sculpture and a median elevation from the clypeus to the base of the antennae; malar space nearly as long as the third antennal joint; front below the ocelli weakly arcuately aciculate; ocelli in a nearly equilateral triangle, posterior pair almost twice as far from one another as from the eye-margin; head above ocelli highly polished, faintly coarsely shagreened; head behind smooth and polished. Antennae with the joints of the flagellum gradually growing shorter, the second scarcely shorter than the first. Pronotum with a strong transverse carina, just behind the raised anterior margin and with a weaker one at the middle. Mesonotum short, no longer than wide, coarsely shagreened; parapsidal furrows complete, bounded interiorly on their posterior half by a raised line, the space between not reticulate. Scutellum with a deep crenate groove at base. Propodeum areolated as in *S. manni*, but with the superomedian and petiolar areas separated and the surface more coarsely sculptured and more shining. Petiole of abdomen stout, considerably curved above, as long as the propodeum to the root of the hind wing, evenly widened from base to apex where it is less than twice as wide as at spiracles; coarsely striate above and on the sides. Second segment with a row of short longitudinal striae at base, followed by an area of very faintly impressed large punctures; apex polished. Following segments smooth, polished. Propleura irregularly reticulate; mesopleura shagreened, with a small reticulate space in front above. Legs stout; hind coxae shagreened, their femora three times as long as thick; none of the tibiæ with denticles or tubercles. Recurrent nervure received near the base of the second cubital cell: submedian cell barely longer than the median; subdiscoidal vein interstitial.

This species is somewhat similar in size and color to the Papuan *S. minutus* Szep., but lighter, with the metathorax not black; the mesothorax shows no transverse sculpture and the head is entirely smooth.

Acanthormius Ashmead.

Proc. U. S. N. M., 1906, **30**, p. 200.

There is a small species in the material before me which is either referable to this genus or represents a closely allied one. As will be seen from the following description the general form and peculiar structure of the abdomen are very similar to *A. japonicus* Ashm., but the armature of the third abdominal segment is not like that of the type-species. It will easily run down to the genus in Ashmead's Genera of Ichneumon flies [1] and his emendation of the same [2] given in connection with the description of the genus. In habitus the species is very much like a Chelonus, but is structurally very different.

ACANTHORMIUS DUBITATUS, sp. nov.

Type.—M. C. Z. 9,055. Solomons: Three Sisters, Malapaina. W. M. Mann.

♀. Length 2.3 mm. Uniformly ferruginous, the legs and three basal joints of antennæ pale yellow. Face evenly convex, smooth and shining; malar space one third as long as the eye; clypeal emargination deep, leaving a large semicircular opening above the mandibles. Front and posterior part of head polished, the latter very strongly margined. Antennae 21-jointed; scape short, oval; pedicel more than half as large as the scape; flagellar joints long, gradually decreasing in length toward apex, basal ones cylindrical, apical ones becoming more or less lanceolate. Mesonotum highly polished with deep crenulate parapsidal furrows that converge and meet before the scutellum; also with a median furrow impressed only behind; scutellum with two large, quadrate, nearly confluent foveae at the base. Propodeum areolated, the superomedian area an equilateral triangle connected with the anterior margin by a median carina, petiolar area pentangular, long, narrowed below. Abdomen consisting of three segments, the second longest, about as wide as long; third a little shorter; first one third shorter; upper surface coarsely longitudinally striated or wrinkled; third segment deeply emarginate at apex and also at the middle of each side, with a small tooth just preceding the lateral emargination; venter pale; ovipositor shorter than the first segment. Propleura with several coarse striae below, mesopleura convex, polished, with a few coarse striae converging from the upper anterior margin toward the centre of the disc; below with a deep elongate impression and just inside the posterior edge with a crenate line; metapleura coarsely rugose. Wings nearly hyaline, with pale brown veins; submedian cell slightly longer than the median; stigma elongate; second section of the radius one third longer than the first;

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[1] Proc. U. S. N. M., 1900, **23**, p. 148.

[2] Ibid., 1906, **30**, p. 200.

radial cell nearly attaining the wing-tip; recurrent nervure interstitial with the first transverse cubitus; submedian cell of hind wing fully half as long as the median.

PLATYBRACON SZÉPLIGETI.

Dr. Mann obtained three species of this remarkable genus on Fulakora. Two species have already been described from the neighboring islands; the type of *P. depressus* Szépligeti from New Guinea and since recorded by him from Aru; the second one *P. insularis* by Cameron from the Solomon Islands. Cameron's species appears to be represented in the collection by 16 specimens. I cannot be positive as the original description is rather incomplete although it fits these specimens so far as it goes. The other two are, I think, perfectly distinct and undescribed. All, however, are very similar, including the Papuan species. The following key will serve to distinguish them.

1. Fourth abdominal segment with a distinct striate or rugose sculpture; antennae entirely black........................2.
   Fourth abdominal segment smooth and shining; antennae ferruginous apically....................................3.
2. Fifth and following abdominal segments rugosely sculptured, the anterior corners of the third and fourth segments rugose. *P. depressus* Szép.
   Fifth and following segments smooth, anterior corners of third and fourth segments smooth..............*P. insularis* Cam.
3. Frontal projection below base of antennae small, in profile projecting only half as far forward as the mandibles; raised area of 1st abdominal segment three times as long as broad. *P. debilis,* sp. nov.
   Frontal projection large, extending as far forward as the mandibles; raised portion of first segment a little over twice as long as broad...................................*P. fortis,* sp. nov.

PLATYBRACON INSULARIS Cameron.

Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 353.

Sixteen specimens, all females, vary in length from 8.5 to 12 mm. but are very uniform in sculpture and in the small size of the facial projection. The raised portion of the first abdominal segment is broad, but little over twice as long as broad and widest near the middle.

PLATYBRACON DEBILIS, sp. nov.

Type.— M. C. Z. 9,056 and *Paratype.* Solomons: Fulakora. W. M. Mann.

♀. Length 9–11 mm. Pale fulvous, the tips of the mandibles, basal three fifths of antennae, ocellar area, and sheaths of ovipositor black; apical two fifths of antennae ferruginous; last tarsal joint fuscous. Wings black, with a pale fulvous basal band as wide as the length of the stigma and a hyaline spot beneath the stigma including most of the first cubital and the extreme base of the radial cell; veins black except at the base of the wing and the first section of the radius which is fulvous; stigma yellowish white. Head a little wider than long, broad and rounded off behind, the part behind the eyes nearly as long as the eyes; malar space shorter than the third antennal joint; transverse ridge below base of antennae poorly developed, but little projecting; above it is a median raised line extending between the antennae and continuing to the ocelli as an impressed line. Antennae 56-jointed. Mesonotum, scutellum, and propodeum smooth and shining, the latter without striae apically, but with the usual groove just outside the spiracle. First abdominal segment as long as broad, its raised portion weakly and irregularly striated, gradually widened behind, three times as long as broad, lateral portions very unevenly longitudinally striate. Second segment over twice as long as broad, its oblique furrows straight, weak, scarcely crenulated, extending two thirds across the segment where they widen out and disappear; lateral areas smooth; middle one coarsely striate except along hind margin; anteriorly with a narrow raised area which extends backward to a point at the posterior third of the segment. Third segment sculptured like the second, but more weakly, without the narrow median portion and with the oblique furrows curved, so that they terminate at the middle of the lateral margins of the segment. Fourth and following segments smooth; the fourth with a curved oblique furrow like the one on the third. Ovipositor a little shorter than the body. Legs stout as usual. Wing-venation as in the other species.

Two specimens, type and paratype from Fulakora, British Solomon Islands, W. M. Mann.

Platybracon fortis, sp. nov.

Type and Paratype.— M. C. Z. 9,057. Solomons: Fulakora. W. M. Mann.

Later two additional females were received by Dr. Mann from Mr. Chas. Bignell, collected at Fulakora.

♀. Length 11–14 mm. Similar to the preceding but with the projecting ridge below the base of the antennae much more highly developed and projecting as far forward as the mandibles when seen in profile. The raised portion of the first abdominal segment is also broader in proportion to its width, only a little over twice as long as broad.

It is possible that this species may be only a well-marked form of the preceding.

Dr. Mann tells me that all the Platybracon which he obtained were flying about felled trees in the forest, so that it is probable that the members of the genus are parasitic on the larvae of wood-boring insects.

Iphiaulax (Atanycolus) bignelli, sp. nov.

Type.— M. C. Z. 9,058. Solomons: Isabel, Fulakora. Charles Bignell.

♀. Length 16 mm., ovipositor 20 mm. Black; the head yellow except ocellar area; pro- and mesothorax, scutellum and four anterior legs fulvous; wings black, the stigma fulvous on basal half; clear spot below stigma present, but not very prominent. Head one third broader than thick, rounded behind, the temples nearly as broad as the eyes. Face rugose, opaque; malar space one third as long as the eye; no keel between antennae; frontal depression with a narrowly v-shaped median elevation. Prothorax above very finely punctate; mesonotum with distinct furrows anteriorly, smooth and polished; scutellum finely punctate behind: metathorax with a few fine scattered punctures, shining. First abdominal segment one half longer than wide at apex, with a high ridge at each side on the basal third enclosing a deep impression; behind the spiracle this ridge curves down to form a lateral carina which is bounded internally by a crenulated furrow, disc of segment strongly elevated, smooth and shining, without carinae; medially behind with a rounded rugose area. Second segment with a finely, irregularly striated median field anteriorly defined by two curved raised lines which meet before the middle of the segment and continue to the apex as a strong median carina; also with an oblique carina on each side from the anterior angle to the posterior margin enclosing an obliquely rugose area, external to this is another similar rugose area that extends only to the middle of the segment. Third segment irregularly longitudinally rugose on basal third, without very distinctly separated anterior angles; fourth segment smooth except at extreme base, anterior angles not separated; following segments entirely smooth and shining. Pleurae smooth except for some delicate oblique aciculations on the propleura anteriorly and for a few fine scattered punctures on the metapleura. Last ventral segment prominent. Outer edge of stigma nearly twice as long as the inner; recurrent nervure received at apical fifth of first cubital cell; second section of radius three times as long as the first.

This species is similar to the Papuan *I. nova guinensis* Szép., but differs greatly in the sculpture of the abdomen, especially on the first segment.

AUSTROÖPIUS NOVA GUINEËNSIS Szépligeti.

Termes. füzetek, 1900, **23**, p. 64.

There is one specimen from Ugi, British Solomon Islands. The species was originally described from New Guinea.

CARDIOCHILES SIMILIS, sp. nov.

Type.—M. C. Z. 9,059. Solomons: Santa Cruz, Graciosa Bay. W. M. Mann.

♂. Length 4.5 mm. Black, conspicuously clothed with white pubescence, especially on the posterior part of the mesonotum and the scutellum. Mandibles, except base and apex ferruginous; anterior legs with the tips of the femora and the tibiae and tarsi fulvous; spurs of four posterior tibiae whitish; palpi piceous; first abdominal segment reddish at the sides; posterior margins of segments 2–4 whitish. Wings deeply infuscated, with a subhyaline band across the middle. Head slightly more than twice as broad as thick, the occiput scarcely excavated; eyes densely hairy, their inner margins weakly convergent below; malar groove almost as long as the width of the mandibles at base; face shining, minutely punctate, without median carina, but with a small median tubercle below the antennae; face, including clypeus, not higher than broad; vertex smooth and shining; ocelli separated by less than their own diameter. Antennae 35-jointed, slender, the joints at the middle nearly half longer than thick. Mesonotum shining, the parapsidal furrows very sharp and crenulate, but narrow; basal groove of scutellum broad, deep and coarsely crenulate. Propodeum smooth in front, coarsely reticulate behind where it is areolate, but irregularly so, the sculpture concealed by the pubescence. First abdominal segment with two longitudinal grooves separating a median portion that is strongly elevated behind; second segment before the transverse groove elevated, but without a median raised area. Propleurae striate below, irregularly punctate above; mesopleura with an irregularly punctate space near the top and below the middle, with a punctate line inside the posterior margin; metapleura smooth; sides of propodeum reticulate. Legs stout. Cubitus arising at the middle of the basal vein; first section of radius shorter than upper section of basal vein.

This species may be the same as *C. fasciatus* Szép. from New Guinea, but it is impossible to tell from the original description (Termes. füzetek, 1900, **23**, p. 60) which omits the structural details of the Papuan species.

BRACON (CREMNOPS) SALOMONIS, sp. nov.

Type and Paratype.— M. C. Z. 9,060. Solomons: Santa Cruz, Graciosa Bay. W. M. Mann. A fourth specimen from Auki has the abdomen entirely yellow.

♂. Length, 7–8 mm. Pale fulvous, marked with black, the mandibles and venter more or less luteus. Head, except for a small ferruginous dot at middle of face, and antennae, black; teeth of mandibles, apical third of hind tibiae and hind tarsi, except extreme base of the joints, black; fifth and also usually the fourth segment of abdomen with a large transverse dark brown or black stain; wings black, the stigma brown basally and the parastigma luteus; discoidal cell with an irregular curved hyaline mark at the base. Head approximately as broad as high; malar space as long as the eye; front shining, finely punctate, almost straight in profile; frontal carinae extending to the lateral ocelli, but not so sharp on their inner half; maxillary palpi one half longer than the labial ones; antennae 40-jointed, scape, simple at apex; third joint distinctly longer than the fourth. Lateral pits of pronotum separated by a narrow median space. Middle lobe of mesonotum with two narrow impressed lines; parapsidal furrows deep, broad and finely reticulated anteriorly. Propodeum with the superomedian area contracted to a point in front, so that it is narrowly triangular; petiolar area subtriangular, as broad as high; in all there are six longitudinal carinae, one strong complete transverse one at apical third and the supermedian and adjacent lateral areas bear four less strongly elevated transverse carinae. Propleurae smooth, with a series of coarse shallow punctures along the hind edge; mesopleura very finely and sparsely punctate, the groove in front of middle coxa almost obsolete; metapleura finely punctate, the punctures well separated. Abdomen highly polished; first segment twice as long as broad at apex which is twice as broad as the base; second segment with a large, oval, weakly convex space at the base. Tarsal claws bifid on all the legs, those of the front tarsi pectinate at the base; hind tibiae with two spines near the base of the spurs; longer spur nearly half the length of the metatarsus. Wings with normal venation; the second cubital cell about two thirds as long above as below.

This species is quite similar to two known from New Guinea; one of these was described by Szépligeti[1] as *Cremnops bicolor,* but as the name *bicolor* has been used by Brullé[2] for an African species of Bracon (*sensu auctorum*), I therefore propose the name *erimensis,* nom. nov. for Szépligeti's species. The second species, *B. xanthostigma,* may be known as *B. nova guineënsis,* nom nov. as *B. xanthostigma* has been used by Cresson[3] for an American species of Bracon (*sensu auctorum*). The present species differs from *B. erimensis* by its shining face, incomplete ocellar carinae, and in color, although a variety described later by Szépligeti[4] is more similar in color. From *B. nova guineënsis* it differs by the triangular superomedian area and in color.

Cameron[5] has described *Agathis fulgidipennis* from the Solomon Islands and this is evidently quite similar to the present Bracon in appearance. However, as the two genera are both well known as distinct and separable on the form of the tarsal claws, I cannot believe that they could be the same. The present species is also similar in color to the Papuan *Euagathis variceps* Cameron, and to *Bracon* (*Agathis*) *fumipennis* Smith.

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[1] Termes. füzetek, 1900, **23**, p. 60.
[2] Hist. nat. ins. hym., 1846, **4**, p. 412.
[3] Proc. Ent. soc. Philadelphia, 1865, **4**, p. 303.
[4] Termes. füzetek, 1902, **25**, p. 66.
[5] Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 356.

DISOPHRYS FUMIPENNIS Smith.

Journ. proc. Linn. soc. Zool., 1859, **3**, p. 176.

Two females from Tulagi probably represent a color-variation of this species which is known also from Aru and New Guinea. The body is entirely luteous, with the antennae, tips of hind tibiae, and entire hind tarsi black. The wings are much lighter basally and the stigma is yellow on the basal half.

CHELONUS SALOMONIS Cameron.

Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 355.

One specimen from Rere.

PHANEROTOMA LONGIPES Szépligeti.

Termes. füzetek, 1900, **23**, p. 59.

A single specimen from Tulagi.

ICHNEUMONIDAE.

ERYTHROPIMPLA NIGRA, sp. nov.

Type.— M. C. Z. 9,061 ♀. Solomons: Rio. W. M. Mann.

♀. Length 13 mm. Black, marked with pale yellow as follows: lower surface of antennal scape, palpi, four anterior legs, except coxae and base of trochanters of middle pair, tegulae, and antetegulae; wings deep yellow on basal two fifths, blackish beyond, veins yellow at base, black beyond, stigma black. Head very transverse, three times as broad as thick; ocelli large, in a small triangle, the lateral ones less than their diameter from the median one and from the eye-margin. Eyes long, touching the mandibles below, deeply emarginate opposite the antennae, strongly convergent for a distance below; face sparsely, finely punctate; clypeus separated by a straight line, its anterior margin deeply emarginate; front and head behind shining and scarcely punctate. Antennae with the first flagellar joint nearly as long as the second and third together, the latter subequal, twice as long as thick; following decreasing in length, becoming quadrate near the middle of the flagellum. Mesonotum punctate, confluently medially, but sparsely on the sides; parapsidal furrows impressed anteriorly. Scutellum strongly convex, nearly truncate behind, coarsely sparsely punctate and clothed with brownish hair as is also the propodeum. Propodeum coarsely densely punctate in front and at the sides, but with a median smooth stripe anteriorly and a large, oval, smooth area behind. Propleura smooth, except for a few punctures near the upper edge; mesopleura sparsely punctate, with a densely punctate space near the tegula and a large smooth area above and behind; with a vertical grooved line extending from the sternum almost to the upper margin opposite the middle of the tegula; sides of propodeum scarcely punctate; spiracle large, oval; metapleura smooth and shining. Abdomen coarsely punctate, more deeply and closely so on the second to fifth segments, except along apical margin; first segment with two strong convergent carinae that almost meet to form a triangular area at the base of the segment; second to fifth each with a basal and subapical transverse constriction, the latter curving forward medially; apical segments without distinct constrictions. Venter white. Ovipositor nearly as long as the abdomen, its sheaths very strongly hairy. Legs moderately stout; tarsal claws with a large, subacute lobe at the base. Stigma very narrow, submedian cell slightly shorter than the median; areolet large, obliquely triangular, subpetiolate above, receiving the recurrent nervure just before apex; transverse discoidal vein in hind wing broken at its lower fifth.

This species will run to either *E. calliptera* Sauss. or *E. pseudoptera* Morl. in Morley's key to the species of Hemipimpla (including Erythropimpla) from both of which it is abundantly distinct.

ECHTHROMORPHA SEMPERI Krieger.

Mitt. Zool. mus. Berlin, 1908, p. 329.
Cameron, Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 362 (*pallidilineata*).
Morley, Revision Ichneumonidae British mus. Nat. hist., 1913, pt. 2, p. 48.

Seven females and ten males from Tulagi; one male from Rere. The females vary in size from 13 to 18 mm., and the males from 8–16 mm. The antennae are blackened on the apical third, especially in the female, but otherwise the specimens agree closely with Cameron's description.

MEGARHYSSA PICEA, sp. nov.

Type and Paratype.— M. C. Z. 9,062. Solomons: Malaita, Auki. W. M. Mann.

♀. Length 19–20 mm.; ovipositor 25–30 mm. Body piceous, varied to only a small extent with lighter color; cheeks and lower posterior orbits fuscous; first three joints of antennae fuscous below, joints 16–19 pale yellow; sides of face below, broader near clypeus, yellow; clypeus, anterior legs, middle and hind femora and tibiae, obscure lateral blotches near apex of first, third, fourth, fifth, and sixth abdominal segments dull reddish brown. One lighter specimen has the orbits yellow for a short distance above the antennae, the posterior orbits yellow, the propodeum and first abdominal segment dull ferruginous, the legs bright ferruginous and yellow spots at the upper edge of propleura, below tegula, at apex of first abdominal segment, and small obscure yellow spots on the sides of segments three to six. Wings brownish, paler at apex and with a blackish fascia, narrowed behind, extending from the costal margin to the discoidal vein, including the basal half of the radial cell and the apical half of the third discoidal cell. Head fully twice as wide as thick, narrowed behind the eyes, in vertical view with the temples one third as wide as the eyes; cheeks but little wider than the temples; face smooth and shining; clypeus with a small median acute tubercle at the middle of its lower margin and another at each lower angle. Flagellar joints gradually decreasing in length, the first distinctly longer than the second. Mesonotum with the usual coarse transverse striations; scutellum transversely rugose-punctate; propodeum shining, not punctate on the sides; its spiracles oval, only twice as long as broad. Propleura entirely smooth; mesopleura smooth above and behind, finely punctate in front; metapleura with small rather closely placed punctures. Abdomen polished, without fine sculpture; petiole scarcely twice as long as broad, widest at basal fourth behind which it is slightly narrowed; second segment twice as long as the first, fully twice as long as wide; third to fifth segments deeply emarginate behind. Legs as usual. Wings with the submedian cell distinctly longer than the median; areolet large, obliquely triangular, petiole about half the height of the areolet; recurrent nervure intestitial with the second transverse cubitus; cubito-discoidal vein in hind wing broken at its upper fifth.

This species is quite distinct in color from the several others known from the Indo-Malayan region. In Morley's key it will run to *M. instigator* Sm. or to *M. tridentata* Cam. which he considers synonymous. From Tosquinet's very lengthy description (Mem. Soc. ent. Belg. 1903, **10**, p. 97) of *M. instigator* it differs in the sculpture of the face, form of clypeus, and more slender abdominal petiole. From *M. tridentata* (Proc. Zool. soc. London, 1901, **1**, p. 230) it differs in the sculpture of the face, propodeum, and metapleurae, dark scutellum, etc.

CYANOXORIDES SPLENDENS, sp. nov.

Type.—M. C. Z. 9,063. Solomons: Fulakora. W. M. Mann.

♀. Length 11 mm. Dark metallic blue; antennae black with joints 11–16 white (apical joints broken off) front and middle tibiae fuscous, their tarsi brownish yellow; hind coxae and femora ferruginous, their trochanters black, their tibiae black with a broad, indistinctly defined, pale brown annulus near base, their tarsi pale testaceous. Wings hyaline with a fuscous band, wider behind, including the basal vein and transverse median nervure, and a second band, fading out posteriorly which extends over the basal half of the radial cell; veins black, stigma pale at base. Head nearly twice as wide as thick, sharply narrowed behind the eyes; ocelli in a nearly equilateral triangle, the posterior pair about half farther from the eye-margin than from one another; face broadly protuberant below the antennae, closely punctate; interantennal keel prominent; antennae slender, the basal flagellar joints five or six times as long as thick, the flagellum hairy, especially beyond the first few joints; mandibles without teeth; front and vertex highly polished almost impunctate except at the sides below the ocelli; cheeks and malar space irregularly vertically striate through the coalescence of rows of elongated punctures; malar space half as long as the first flagellar joint. Mesonotum with weakly impressed parapsidal furrows; densely punctate with an area on each side that is sparsely punctate. Scutellum convex, rugosely punctate with a small median smooth depression on its apical half. Propodeum rather evenly convex above; coarsely rugose-punctate; areolated; median areas not separated from each other; basal and apical lateral areas completely defined; pleural space defined by a carina below it; spiracles linear. Propleura coarsely punctate above, smooth below; mesopleura coarsely punctate, confluently so near the middle coxa; metapleura rugose. Abdomen subpetiolate, the first segment slightly longer than the propodeum and scutellum together, its base one fourth as wide as the apex; its surface very coarsely punctate, rugose medially and with a patch of oblique striae at the inner end of the oblique grooves; spiracles distinctly before the middle. Second segment slightly more than half as long as the first, broadest behind and distinctly shorter than wide; with a curved impression on each side that extends from the middle of the anterior margin to the middle of the lateral one; anterior corners separated by a short, deep oblique groove, surface confluently punctate on the raised portions and obliquely striate on the depressed parts. Third segment shorter than the second and similarly sculptured, but with much less evident striae; following segments smooth and shining. Hind legs very long, with the coxae and femora thickened; front tibiae twisted and constricted at the base; tarsal claws simple. Ovipositor as long as the body. Submedian cell distinctly shorter than the median; transverse cubitus long, one third the length of the recurrent nervure; transverse discoidal vein in hind wing broken below the middle.

To judge from the generic description of Cyanoxorides, this species is atypical in having a more nearly petiolate abdomen, with the spiracle of the first segment placed before the middle. It is so typical in all other respects, however, that it is undoubtedly congeneric with Cameron's species.

Enicospilus Stephens.

There are four species of this genus in the collection, three of which are apparently undescribed, together with *E. salomonis* Cameron. They may be distinguished by the following key.

1. Submedian cell of same length as the median; abdomen black beyond second segment; wing-venation very dark. Plate 1, fig. 1. *E. fulacorensis*, sp. nov.
   Submedian cell shorter than the median; abdomen entirely reddish; wing-venation brown..2.
2. Propodeum finely sculptured; cubito-discoidal cell with two widely separated, chitinous spots, one near each end of the first section of the radius. Plate 1, fig. 4..........*E. salomonis* Cam.
   Propodeum coarsely reticulate, especially toward apex; chitinous spots not as above......................................3.
3. Recurrent nervure as long as the transverse cubitus; metapleura finely, closely punctate. Plate 1, fig. 3. .*E. approximatus*, sp. nov.
   Recurrent nervure nearly twice as long as the transverse cubitus; metapleura irregularly sculptured, more or less rugose and striate. Plate 1, fig. 2......................*E. malaitensis*, sp. nov.

Enicospilus fulacorensis, sp. nov. Plate 1, fig. 1.

Type.— M. C. Z. 9,064. Solomons: Fulakora. W. M. Mann.

♀. Length 22 mm. Light reddish brown; abdomen piceous beyond the second segment; front and middle legs beyond the coxae, hind trochanters, knees, tibiae, and tarsi, and mandibles except tips dull yellow; flagellum of antennae black; sides of face and front, and posterior orbits pale yellow; wings hyaline, with the venation piceous, almost black. Face very finely and sparsely punctate, clypeus smooth and polished; malar space a little shorter than the thickness of the third antennal joint. Mesonotum not distinctly punctate. Scutellum carinate laterally, the carinae straight, twice as far apart at base of scutellum as at apex; apical half coarsely longitudinally striate. Propodeum smooth and shining before the carina, behind this evenly rugose-reticulate, the reticulations rather distinctly oblique. Mesopleura longitudinally finely striate below, indistinctly so above; metapleura coarsely striate below, finely so above. Posterior tibiae with a few dark bristles externally in addition to the yellow pubescence. Median cell as long as the submedian; chitinous spot in cubito-discoidal cell prolonged apically as a curved line almost to the radius; first section of radius thickened on the basal two thirds; base of third discoidal cell half as long as the apex of the second discoidal; discoidal vein in hind wing broken at lower third.

Type from Fulakara, British Solomon Islands, Wm. M. Mann.

This species is very similar in color to *E. nigrinervis* Cameron from New Britain, but differs at once in the length of the submedian cell and longitudinally striate scutellum.

Enicospilus malaitensis, sp. nov. Plate 1, fig. 2.

Type.— M. C. Z. 9,065. Solomons: Malaita. W. M. Mann.

♂. Length 22 mm. Light yellow-brown, the antennae fuscous toward tips; inner orbits above pale yellow. Wings hyaline, veins fuscous. Face finely closely punctate, clypeus more sparsely so, especially below. Malar space slightly longer than the diameter of the first flagellar joint. Mesonotum closely, very finely punctate. Scutellum with straight lateral carinae, its surface finely punctate, without striae, rather broad, twice as wide in front as at apex. Propodeum smooth and impunctate before the carina, coarsely reticulate behind it. Mesopleura finely punctate above, longitudinally aciculate below; metapleura irregularly rugose-striate, without any distinct punctures. Posterior tibiae with a few short bristles externally in addition to the pubescence. Submedian cell much shorter than the median; cubito-discoidal cell with a chitinous triangular spot just beyond the middle, prolonged as a thin line nearly to the radial vein; discoidal vein in hind wing broken at lower third.

ENICOSPILUS APPROXIMATUS, sp. nov.

Plate 1, fig. 3.

Type.— M. C. Z. 9,066. Solomons: Malaita, Auki. W. M. Mann.

♀. Length 20 mm. Uniformly pale yellowish brown, without lighter markings and with only the tips of mandibles and tarsal claws black. Wings hyaline, venation piceous. Face and clypeus polished, not distinctly punctate; malar space only about half as long as the diameter of the first flagellar joint. Mesonotum minutely punctate. Lateral carina of scutellum straight; scutellum not striate toward apex which is half as broad as the base. Propodeum punctulate and shining before the carina, behind it reticulate, much more finely so anteriorly near the carina. Mesopleura below finely closely punctate, not distinctly striate; metapleura finely densely punctate above, sparsely so below. Hind tibiae without fine bristles in addition to the pubescence. Median cell longer than the submedian; cubito-discoidal cell with two chitinous spots close together, the basal one triangular and joined to the apical, arcuate one by an almost imperceptible brown line, discoidal vein in hind wing broken at the lower third.

LEUCOSPIDAE.

LEUCOSPIS MACRODON Schletterer.

There are three specimens of this rather widely distributed species from Fulakora, Auki, and Malaili. Two are quite typical, agreeing in color with the original description and with Papuan specimens, while another is entirely black, except for the antennal scape, an oblique stripe on each side of the front opposite the scape, a spot at the upper angle of the hind coxa, a stripe along the upper edge of the femur, most of the four anterior legs and the posterior tarsi which are yellow or brownish yellow. The melanic specimen is, however, structurally the same as the fully marked specimens.

Chalcididae.

Chalcis Fabr.

There are four species of Chalcis in the present collection, including one already described from the Solomons, and another, *C. euploeae*, which is apparently widespread in the Indo-Malayan region. The following key will distinguish the four species.

1. Cheeks, below eye and behind malar carina, with coarse reticulate sculpture; hind femora tricolored, black with rufous spot before apex which is white. . . . . *terribilis,* sp. nov.
   Cheeks punctate or nearly smooth; hind femora bicolored, black with the apex yellow or white. . . . . 2.
2. Four anterior legs entirely lemon-yellow beyond the middle of the femora; hind tibiae entirely yellow except at extreme base. *euploeae* Westw.
   Four anterior legs with the femora black except at tip; all tibiae white or yellow varied with black. . . . . 3.
3. Hind tibiae black, with a white stripe externally except at base; middle tibiae white with a black stripe internally. *C. salamonis* Cam.
   Hind tibiae black, yellow externally at extreme base; middle tibiae black, yellow at base and apex. . . . . *C. piraticus,* sp. nov.

Chalcis terribilis, sp. nov.

Type.—M. C. Z. 9,067. Solomons: Rere. W. M. Mann.

♀. Length 5 mm. Black, tegulae with a large white spot; front femora white behind near tip and at extreme tip in front, their tibiae brown with a white streak externally at base and spot at base; middle legs with knees and tip of tibiae yellowish white; hind femora white at extreme apex and with a subapical rufous spot externally, their tibiae externally with a white spot near base and at apex; all tarsi pale brownish yellow. Head above umbilicately punctate; front between antennal cavity and eye with a strong carina extending along lower two thirds of eye; cheeks very coarsely sculptured, irregularly punctate-reticulate; malar carina weak, curving backward before meeting the eye; subgenal and postgenal carinae strong. Antennae very stout, flagellar joints after the second fully twice as wide as long, those near apex nearly three times. Eyes bare; head and body hairs glistening white. Thorax above umbilicately punctate; lateral carinae of prothorax well developed; each as long as the median space between them. Scutellum at apex with a deeply bilobed projection. Abdomen smooth, with very fine punctures on the sides of the third and following segments. Hind femur about twice as long as wide, with a small projection inwardly near base, their inner surface smooth, outer surface very sparsely and finely punctate; about 13 femoral teeth, basal ones, except first, and apical ones smaller than the others. Wings nearly hyaline; postmarginal vein half as long as the marginal and twice as long as the stigmal.

C. terribilis may be known by the configuration of the facial carinae and banner-like color-pattern of the hind femora.

CHALCIS PIRATICUS, sp. nov.

Type and Paratypes.— M. C. Z. 9,068. Solomons: Malaita. W. M. Mann.

♀. Length 3.2–4 mm. Black; the tegulae pale yellow; front and middle knees, tips of tibiae and tarsi honey-yellow; extreme apices of hind femora, ring including basal fourth of tibiae, apex externally of tibiae, and tarsi, yellow. Pubescence of body whitish. Head rugose-punctate above; ocelli in a low triangle, the lateral ones less than their diameter from the eye-margin, eyes bare or nearly so; cheeks smooth; malar carina dividing just below eye, one branch extending along the inner orbit as a light carina, the other branch extending to the hind margin of the head so as to enclose the cheek in the form of a rhomboid between carinae. Antennae rather slender, the middle joints of the flagellum less than twice as broad as long. Thorax closely umbilicately punctate; lateral carinae of pronotum weakly developed, each about as long as the space between them. Scutellum simple, sharply rounded at apex. Abdomen shining, sides of third to sixth segments faintly shagreened, hairy: apical two segments coarsely shagreened. Posterior femora very broad, distinctly more than half as wide as long; internally near base without distinct tubercle, although there is a slight trace of one; underside with about

13 teeth, basal one large, triangular, next small, next larger than the following which form a decreasing series; outer surface finely, closely punctate; inner surface very finely and sparsely punctate. Postmarginal vein one third as long as the marginal and one half longer than the stigmal.

Known from the others occurring on these islands by the almost entirely black hind femora, with minute yellow marking at tip.

CHALCIS SALOMONIS Cameron.

Proc. Linn. soc. N. S. Wales, 1911, **36**, p. 349.

One female from Ugi.

CHALCIS EUPLOEAE Westw.

Trans. Ent. soc. London, 1837, **2**, p. vi Proc.

One specimen from Yandina.

SCELIONIDAE.

SCELIO SETIGER, sp. nov.

Type.—M. C. Z. 9,069. Solomons: Ugi. W. M. Mann.

♀. Black, the four anterior tibiae and tarsi fuscous, front wings strongly infuscated, hind ones hyaline. Front and vertex reticulate, with shallow, thimble-like punctures; a small smooth area above the median ocellus and a triangular smooth space above the base of antennae; reticulations of front below on the sides forming several raised lines that converge toward the base of the mandible; malar furrow nearly half as long as the eye; cheeks and back of head irregularly reticulate, more coarsely so on the cheeks which have no striae of any kind. Head seen from above twice as wide as thick, strongly excavated behind, the lateral ocelli very close to the eye-margin. Antennae stout; scape reaching to level of middle of eye; first flagellar joint one half longer than the pedicel, strongly narrowed basally, slightly over twice as long as thick at tip: three following joints widened, twice as wide as long and really forming a part of the club in form except that they appear to be much more freely movable; basal joints of club fully twice as wide as long. Thorax coarsely rugose-reticulate; mesonotum without parapsidal furrows, although all its reticulations form more or less distinctly longitudinal series. Prothorax smooth, lightly punctured on its contracted part, behind reticulate, with a slight but noticeable tooth at the humeral angle. Scutellum very convex, semicircular, with large punctures forming reticulations, each puncture bearing a short stiff hair or bristle, as do also the punctures of the mesonotum, although here the hairs are not so conspicuous and stout. Metanotum (postscutellum) projecting very slightly as a fluted ridge; propodeum strongly depressed coarsely rugose medially and behind, finely so laterally where it is clothed with dense short whitish hair. Abdomen of the usual form, the first five segments rather regularly longitudinally striate, striae coarser on the first and more irregular on the third segment; apical margin of second to fourth, wider medially on the third and fourth, smooth and shining; sixth segment with deep, large setigerous punctures, third segment the largest, a little wider than long. Propleurae rugose-punctate, more coarsely so behind, mesopleurae with a few very irregularly placed punctures of variable size and shape; sides of propodeum coarsely reticulate anteriorly, finely so behind. Underside of abdomen sculptured almost like the upper side. Costal vein sharply defined, fuscous; stigma small, dark brown as is also the oblique stigmal vein.

This species is readily distinguishable from others occurring in the Indo-Malayan region by its dark color, infuscated wings, sculpture of head and cheeks, etc. In Kieffer's key (Ann. Soc. sci. Bruxelles, 1908, **32**, p. 124) which is quite complete, it runs near *S. minor* Voll. from Maderia and *S. fulvipes* Först, from Germany.

CACELLUS CAERULEUS, sp. nov.

Type.— M. C. Z. 9,070. Solomons: Santa Cruz, Graciosa Bay. W. M. Mann.

♀. Length 7 mm. Dark metallic blue, legs and antennae entirely black; wings heavily infuscated, the hind ones subhyaline at base, the fore ones dark fuscous anteriorly near the base. Front very deeply and coarsely confluently punctate, with a short median smooth stripe above the base of the antennae; occiput coarsely rugose, temples and cheeks sculptured like the front; malar space short, with a deep furrow; cheeks wide, but temples very narrow; eyes bare, convergent on the front above; ocelli large, in a small equilateral triangle, separated from one another by their own diameter, but almost touching the eye. Mandibles broad, tridentate. Antennae with long, cylindrical scape, nearly as long as the eye-height; first flagellar joint over twice the length of the pedicel and over one third as long as the scape; second flagellar joint wider, twice as long as wide; third wider, quadrate, fifth and following which form the rather slender club transverse, those near the middle of the club twice as wide as long. Thorax and scutellum above very coarsely punctate, the punctures forming longitudinal rugae on the sides of the pronotum and a more or less distinct row just outside the well-marked parapsidal furrows; no median furrow on mesonotum, although there are two short indistinct ridges anteriorly between the parapsidal furrows. Scutellum rounded behind; postscutellum unarmed, visible only as a series of deep foveate punctures under the edge of the scutellum. Propodeum medially raised almost to the level of the scutellum as a triangular portion, pointed behind where it is minutely bidentate; on sides below this smooth, followed by a carina below which the surface is concealed by a rather dense coat of short white hair. Propleurae smooth and polished anteriorly, white, hairy on the posterior strip; mesopleura with a smooth oblique depression, below and anteriorly coarsely strigose, behind with a series of foveae, hairy in front; metapleura rugose-reticulate beneath the hair which is less dense than that on the lower part of the propodeum. Abdomen about half longer than the head and thorax together, with six visible segments; first as long as wide, but little narrowed basally, coarsely longitudinally striate; second and third segments of equal length and similar sculpture, the third quadrate, but the second narrower basally; surface longitudinally striate-reticulate, with series of fine punctures between the reticulations, laterally with a sharp carina which extends also along the sides of the first and fourth segments; medially with a raised line which extends over the fourth segment and indistinctly beyond; fourth segment slightly shorter than the third, quadrate, similarly sculptured; fifth as long as wide, considerably narrowed behind, the lineate sculpture less evident, sixth small, triangular, entirely without lineations but retaining the punctures; all sutures smooth, impunctate; venter coarsely, sparsely punctate, much more convex than the dorsum. Legs rather slender, the tarsal claws simple. Marginal vein rather long, about five or six times as long as thick; stigmal oblique, knobbed, nearly one third longer than the marginal; basals, submedian, and radial veins indicated strongly as dark streaks; cubital and discoidal ones indistinctly so in the same way.

This is a large, beautiful species and should be easily recognized. Although I have not been able to compare it with the type-species of Cacellus it agrees perfectly with the original description of the genus and is congeneric with American species which I refer to Cacellus.

BETHYLIDAE.

APENESIA MALAITENSIS, sp. nov.

Type.— M. C. Z. 9,071. Solomons: Malaita, Auki. W. M. Mann.

♀. Length 4.8 mm. Head, thorax, antennae, and legs pale yellowish brown; abdomen piceous with the apical margins of the basal segments and the sixth and seventh segments entirely fuscous or honey-yellow. Head to apex of clypeus about one fourth longer than wide, slightly narrowed above, with the upper angles obliquely rounded; occipital margin concave; eyes minute, oval, smaller than the pedicel of the antennae, inserted very close to the mandibles; clypeus sharply elevated medially; mandibles bidentate, apical tooth much larger than the inner one. Front and back of head with faint traces of longitudinal aciculations and with a few large scattered punctures. Antennae 13-jointed, barely reaching the vertex; scape thick, obclavate, over half as long as the remainder of the antennae; pedicel globose, as long as the first flagellar joint, second and third flagellar joints each about as long as the first, and somewhat broader; following much broader, transverse; last joint twice as long as the preceding, broadly rounded at tip. Pronotum one half longer than wide, sculptured like the head, rounded in front, truncate behind; neck visible from above, one third as long as the pronotum, rounded in front; pleurae visible from above, appearing one fourth as wide as the pronotum. Middle lobe of mesonotum subtriangular, nearly as long as wide and rounded behind; lateral lobes about twice as long as the median one, the whole mesonotum one half wider than the pronotum, its surface smooth. Propodeum constricted just beyond basal third, a little wider behind than in front; anterior margin concave; apex evenly rounded; upper surface indistinctly longitudinally aciculate, with a few scattered large punctures. Abdomen smooth, as long as the head and thorax together; sparsely clothed with long hairs on the sides, more conspicuously so toward the apex; second segment the longest, quadrate; following growing gradually shorter and narrower. Legs very stout, especially the front femora; middle tibiae strongly, irregularly bispinulose along the posterior surface. Tarsal claws simple.

This species resembles the Papuan *A. proxima* Kieffer in color but differs in the punctate head.

List of Species.[1]

STEPHANIDAE.

Stephanus froggattii Cam.	Solomon Is.
Proc. Linn. soc. New South Wales, 1911, **36**, p. 357. Antea, p. 98.	
Stephanus violaceipennis Cam.	New Britain.
Proc. Zool. soc. London, 1901, **1**, p. 225.	
Parastephanellus maculifrons Cam.	Bismarck Archipelago.
Journ. Roy. Asiatic soc. Straits branch, 1902, no. 37, p. 32.	
Parastephanellus orbitalis Brues.	Solomon Is.
Antea, p. 98.	
Diastephanus salomonis Westw.	Solomon Is., New Hebrides.
Thesaur. entom. Oxon., 1874, p. 128. Antea, p. 100.	

EVANIIDAE.

Gasteruption viridescens Kieff.	New Britain.
Berliner entom. zeits., 1906, **51**, p. 273.	
Trigonofoenus salomonis Brues.	Solomon Is.
Antea, p. 101.	
Evania erythrocnemis Schlett.	New Britain.
Ann. K.-k. naturh. hofmus. Wien, 1889, **4**, p. 158.	
Evania mediana Schlett.	New Britain.
Ann. K.-k. naturh. hofmus. Wien, 1889, **4**, p. 157.	
Evania muelleri Schlett.	New Britain.
Ann. K.-k. naturh. hofmus Wien., 1889, **4**, p. 170.	

BRACONIDAE.

Spathius manni Brues.	Solomon Is.
Antea, p. 102.	
Spathius melleus Brues.	Solomon Is.
Antea, p. 103.	
Acanthormius dubitatus Brues.	Solomon Is.
Antea, p. 105.	
Pegarthrum fuscipenne Cam.	Solomon Is.
Proc. Linn. soc. New South Wales, 1911, **36**, p. 355.	
Platybracon debilis Brues.	Solomon Is.
Antea, p. 107.	

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[1] Distribution outside the included area is not cited, see p. 97–98.

Platybracon fortis Brues. Antea, p. 108.	Solomon Is.
Platybracon insularis Cam. Proc. Linn. soc. New South Wales, 1911, **36**, p. 353. Antea, p. 106.	Solomon Is.
Iphiaulax bignelli Brues. Antea, p. 108.	Solomon Is.
Nedinoschiza cratocephala Cam. Proc. Linn. soc. New South Wales, 1911, **36**, p. 354.	Solomon Is.
Cratobracon ruficeps Cam. Proc. Zool. soc. London, 1901, **1**, p. 227.	
Bracon (auct.) diores Cam. Proc. Zool. soc. London, 1901, **1**, p. 226.	New Britain.
Bracon (auct.) leucostigmus Cam. Proc. Linn. soc. New South Wales, 1911, **36**, p. 352.	Solomon Is.
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Eristicus froggattii Cam. Proc. Linn. soc. New South Wales, 1911, **36**, p. 359.	Solomon Is.
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Proc. Zool. soc. London, 1901, **1**, p. 233. Solomon Is.
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Antea, p. 115.
Echthromorpha bitecta Morley. New Caledonia.
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Echthromorpha diversor Morley. Solomon Is. or New Hebrides.
Revis. Ichneumonidae British mus. Nat. hist., 1913, pt. 2, p. 47.
Echthromorpha equisita Morley New Caledonia.
Revis. Ichneumonidae British mus. Nat. hist., 1913, pt. 2, p. 40.
Echthromorpha inermis Morley. New Caledonia.
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Antea, p. 113.
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Erythropimpla pallidiceps Cam. Solomon Is.
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Exeristes consimilis Morley. New Hebrides.
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Lissopimpla pacifica Morley. New Caledonia.
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Megarhyssa fulva Cam. (nec Voll.) New Britain.
Proc. Zool. soc. London, 1901, **1**, p. 229. (Rhyssa)
(= fasciata Sm.?).
Megarhyssa picea Brues. Solomon Is.
Antea, p. 114.
Megarhyssa tridentata Cam. New Britain.
Proc. Zool. soc. London, 1901, **1**, p. 230. (Rhyssa)
(= instigator Sm.?).
Theronia flavistigma Morley. Solomon Is.
Revis. Ichneumonidae British mus. Nat. hist., 1914, pt. 3, p. 47.
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Proc. Zool. soc. London, 1901, **1**, p. 231.
Eremotylus longiventris Cam. New Britain.
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Enicospilus approximatus Brues. Solomon Is.
Antea, p. 118.
Enicospilus fulacorensis Brues. Solomon Is.
Antea, p. 117.

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Antea, p. 117.
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Revis. Ichneumonidae British mus. Nat. hist., 1912, pt. 1, p. 53.
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Proc. Zool. soc. London, 1901, **1**, p. 228.
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Antea, p. 121.
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Antea, p. 120.
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Antea, p. 119.

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SCELIONIDAE.

Cacellus caeruleus Brues. Antea, p. 122.	Solomon Is.
Scelio setiger Brues. Antea, p. 121.	Solomon Is.

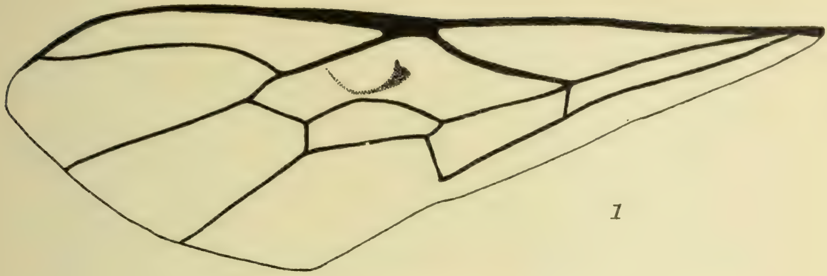
BETHYLIDAE.

Apenesia malaitensis Brues. Antea, p. 124.	Solomon Is.

PLATE 1.

PLATE 1.

Fig. 1. Enicospilus fulacorensis, fore wing.
Fig. 2. Enicospilus malaitensis, fore wing.
Fig. 3. Enicospilus approximatus, fore wing.
Fig. 4. Enicospilus salomonis, fore wing.



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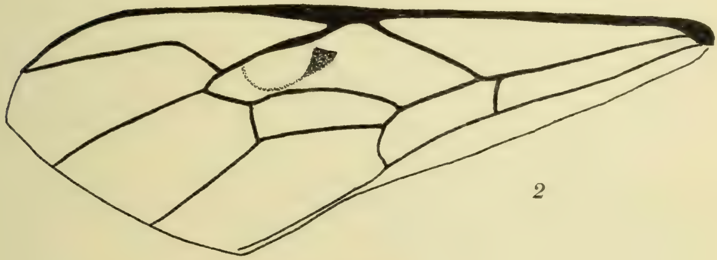

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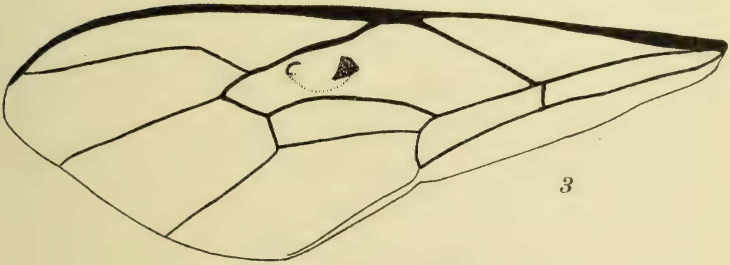

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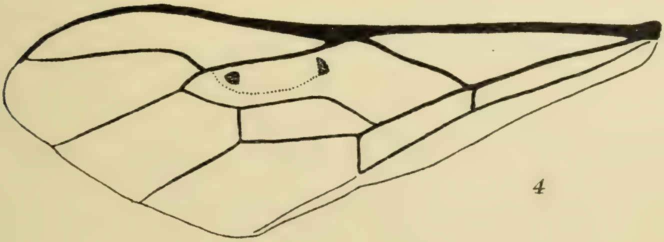

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LOUIS CABOT. Immature State of the Odonata, Part IV.
E. L. MARK. Studies on Lepidosteus, continued.
E. L. MARK. On Arachnactis.

Reports on the Results of Dredging Operations in 1877, 1878, 1879, and 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," as follows:—

A. MILNE EDWARDS and E. L. BOUVIER. The Crustacea of the "Blake."
A. E. VERRILL. The Alcyonaria of the "Blake."

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieutenant Commander Z. L. Tanner, U. S. N., Commanding, in charge of Alexander Agassiz, as follows:—

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Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding, as follows:—

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H. L. CLARK. The Holothurians.
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PUBLICATIONS

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Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieut. Commander Z. L. Tanner, U. S. N., Commanding, in charge of Alexander Agassiz.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding.

Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from October, 1904, to April, 1905, Lieut. Commander L. M. Garrett, U. S. N., Commanding.

Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
Vol. LXII. No. 7.

THE ANTS OF THE GENUS OPISTHOPSIS EMERY.

By William Morton Wheeler.

With Three Plates.

CAMBRIDGE, MASS., U. S. A.
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Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905, Lieutenant Commander L. M. Garrett, U. S. N., Commanding, published or in preparation: —

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A. AGASSIZ. I.[1] Three Letters to Geo. M. Bowers, U. S. Fish Com.

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H. B. BIGELOW. XXVI.[26] The Ctenophores.

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C. A. KOFOID and E. J. RIGDEN. XXIV.[24] The Protozoa.

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R. VON LENDENFELD. XXIX.[29] Hexactinellida.

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HARRIET R. SEARLE. XXVIII.[28] Isopods.

H. R. SIMROTH. Pteropods, Heteropods.

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[1] Bull. M. C. Z., Vol. XLVI., No. 4, April, 1905, 22 pp.
[2] Bull. M. C. Z., Vol. XLVI., No. 6, July, 1905, 4 pp., 1 pl.
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[29] Mem. M. C. Z., Vol. XLII., June, 1915, 397 pp., 109 pls.
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No. 7.— *The Ants of the Genus Opisthopsis Emery.*

By William Morton Wheeler.

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION, HARVARD UNIVERSITY, No. 142.

The species of the singular Camponotine genus Opisthopsis are confined to the Australian and Papuan regions and are readily distinguished from other ants by their usually striking coloration and very large and prominent eyes, situated at the posterior corners of the head. The first, or type-species was described in 1864 by Frederick Smith, under the name *Formica* (*Myrmecopsis*) *respiciens* from New Guinea. As Guérin had given the name Myrmicopsis in 1830 to a genus of Mutillidae Emery in 1893 saw fit to change that of the ant-genus to Opisthopsis. This was hardly justified by the rules of nomenclature, because Smith's and Guérin's names differed by a letter. Forel, however, discovered that Myrmecopsis had been used by Newman as early as 1850 for a genus of Lepidoptera, so that Emery's name became valid.

Our knowledge of the species of Opisthopsis has grown very slowly. Up to the present time five species and a subspecies have been added to the genus by Emery and Forel. The material on which these were based seems to have been rather meager. Several of the described forms were evidently known to Mayr in 1876 but he regarded them merely as color varieties of the typical *respiciens*. Emery and Forel, however, believe that these color forms are relatively constant and therefore regard them as distinct species. While in Australia during the winter of 1914 to 1915 I collected a considerable number of Opisthopsis and have since received a series of specimens from the Museum of South Australia and a species collected in the British Solomon Islands by Dr. W. M. Mann. A study of this material, comprising, in addition to all but one of the previously known forms, five undescribed species and as many varieties, shows that the genus is very homogeneous. The various forms differ from one another by slight peculiarities in the structure of the head and thorax, sculpture and pilosity, correlated with more conspicuous differences in coloration. A consistent "lumper" would probably regard all the forms as merely so many varieties or subspecies of a single variable species, but as the color differences are constant within certain easily discernible limits, I follow the example of Emery and Forel and recognize eleven species. Two of these, *pictus* Emery and *rufithorax* Emery, should probably be united, as the former is unusually variable in color and has one variety that is transitional to *rufithorax.* I may add that although I have examined more specimens of Opisthopsis than any previous worker, the final decision as to the limits of the species, subspecies, and varieties must be left to the resident Australian entomologist who can make an intensive study of the geographical distribution of the group. My account of these insects will, I trust, show that both their habits and taxonomy merit closer investigation.

The genus Opisthopsis is evidently very largely confined to Australia, as only one species (*O. linnaei*) is known from the Bismarck Archipelago, one (*O. respiciens*) from New Guinea and one (*O. manni*) from the Solomon Islands. *Opisthopsis respiciens,* moreover, is common also in Northern Australia and *O. haddoni* may occur in New Guinea. The precise ranges of the various Australian species cannot be given at the present time. Forel's statement that *O. respiciens* is "in ganz Australien verbreitet," is, I am sure, erroneous. I failed to find any Opisthopsis in Eastern Australia south of Brisbane, Queensland (27° 30′ S.), and with the exception of some specimens of *O. rufithorax,* I have seen none taken in a more southern latitude. Froggatt does indeed record *O. respiciens* from New South Wales and Mayr cites it from Sydney, but Froggatt's specimens may have been collected near the Queensland border and Mayr's may have been specimens of *rufithorax.* All the species I have seen in the field were living at low elevations in the dense "scrub" (tropical rain forest) or dry, open "forest" of Queensland. *Opisthopsis respiciens* seems to prefer the former, the paler, yellow species (*haddoni, major, jocosus, rufithorax,* etc.) the latter situations.

The workers are usually seen running in the bright sun-light up and down the trunks of large trees, especially of the genera Eucalyptus and Melaleuca, with rapid, jerky movements like those of our large-eyed, neotropical Pseudomyrmas. They have extremely acute vision, as would be inferred from the large size, very fine facetting and peculiar position of the eyes, and are therefore very difficult to catch, as they look backward as well as sidewise and forward and dodge about with such adroit zigzag movements that it is almost impossible to seize them with the tweezers or fingers. I finally resorted with greater success to slapping them with the hand, but this is apt to crush them or to make them fall from perpendicular surfaces.

The interesting resemblance of these ants to the large-eyed, arboreal and bright-colored species of Pseudomyrma in the Neotropical and of Sima in the Palaeotropical region led me to look for their nests in the trees, but I failed in this quest and concluded that the nests must be at inaccessible heights in the trunks or branches. Through a fortunate accident, however, at Koah, near Kuranda, Queensland, I discovered the nests of one species, *O. haddoni.* In this arid forest region there are innumerable termite nests of all sizes from a foot or two to six or seven feet in height. I found that the smaller nests could be easily broken off at the base and turned over by a sharp kick with the foot. This exposed the galleries in the base of the termitarium and to my surprise I found them in nearly every nest inhabited by a colony of the beautiful orange and black *haddoni.* Such study as I could make in the field showed that the ants take possession of the galleries by replacing the termites, which retreat to the upper portion of the nest-cone. Perhaps the ants feed very largely on the soft-bodied termites, although the latter were not molested when they happened to creep into galleries inhabited by the ants. From this and the further fact that I found *haddoni* nesting by itself under stones only on one occasion, I infer that this ant is regularly termitophilous. Later I again found *haddoni* nesting in precisely the same manner in termitaria near Townsville, Queensland.

On my return to the United States I learned that Dr. E. Mjöberg (in Forel, Ark. f. zool., 1915, **9**, p. 95) had recently made similar observations on *O. haddoni* in the Kimberley District of North West Australia and at Laura, Cape York and Colosseum, Queensland. He also succeeded in finding the nests of *O. rufithorax* "in clay about the roots of trees." Nevertheless this terrestrial method of nesting is by no means universal in the genus. Dahl discovered the nests of *O. linnæi* in tree-trunks in the Bismarck Archipelago, and Mann recently found a nest of *O. manni* in a similar situation in the Solomon Islands. In all probability *O. respiciens* will be found to have similar habits.

The colonies of *O. haddoni* are rather small, comprising only about 100 to 200 workers with a single or several deälated queens. The larvae are white and plump and covered with short, simple hairs. They spin pale buff-colored cocoons like most Camponotinae. It is easy to capture the ants in their nest as they seem to be dazed when the termitarium is suddenly broken in two and the light let into their galleries. In this connection I may state that numerous other ants are quite as regularly found nesting in termitaria at Koah and Townsville, Queensland. In both localities the very pugnacious *Iridomyr-*

mex sanguineus was found only in termitaria, usually in the upper portions, but often throughout the structure. At Koah I found also three species of *Polyrhachis* of the subgenus *Chariomyrma* (*cyrus, senilis,* and *comata*) and *Camponotus* (*Myrmogonia*) *rubiginosus* in the smaller termite nests, the former frequently, the latter as a regular inquiline. It builds on the surface of the termitarium a small, chimney-like entrance, which is guarded by one of the large-headed major workers. *Euponera* (*Brachyponera*) *lutea* and two forms of *Camponotus* (*Myrmoturba*) *maculatus* are also occasionally found in termitaria but nest much more frequently under stones and logs.

Not only is *O. haddoni* a regular inquiline in the nests of another insect, but it seems to be itself the host of other species of Opisthopsis! In several of the nests at Koah I found from one to six very dark brown or black workers among the bright yellow *haddoni.* In my opinion they belong to two distinct species, which are described below as *O. maurus* and *lienosus.* The fact that they occurred in *haddoni* colonies in which males and females were hatching, would seem to be fatal to the view that they are true parasites. That they are very aberrant or diseased workers of *haddoni* seems to me improbable, because the workers of this species are very constant in coloration and because the dark individuals exhibit peculiarities of form and sculpture as well as of color. I believe that *haddoni,* like many other ants, may occasionally kidnap the brood of alien species and that the dark individuals may have been reared from cocoons thus procured.

The males of Opisthopsis seem not to have been seen by previous observers and the females of only a few of the species have been described. The males are of the same size as the workers and very much like the males of Camponotus, with which genus Opisthopsis is evidently very closely related. Forel, in a recent classification of the subfamily Camponotinae, places Opisthopsis in the tribe Camponotini and shows that its proventriculus ("gizzard") has essentially the same structure as in Camponotus, being long and slender, with a straight, *i. e.* nonreflected calyx (Plate **3**, fig. 29). Opisthopsis cannot, however, be regarded as an offshoot of the genus Camponotus, owing to the fact that the former has a discal cell in the fore wing. This represents a more primitive condition than in Camponotus, where the discal cell is always absent. We must conclude, therefore, that both Opisthopsis and Camponotus have had a common origin from some more ancient, extinct genus with a venation more like that of Formica. Attentive examination of the workers of Opisthopsis shows that they have a feeble tendency to dimorphism in the shape of the head, the larger individuals having the region in front of the eyes more convex on the sides than the smaller individuals. In one speclos (*O. jocosus*) the dimorphism is very distinct.

In the figures accompanying this article I have endeavored to indicate the extent of the black or dark brown markings by stippling. The color of the eyes is peculiar. The retinal pigments are either very unstable and fugitive, so that they disappear in alcohol, or the eyes are in many of the species of an unusual pale gray or whitish color in life. Unfortunately I failed to note the eye-color in living individuals. In the descriptions I have recorded it as it appears in the dried specimens.

OPISTHOPSIS Emery.

Worker. Small, monomorphic or slightly dimorphic; thorax, petiole, and gaster resembling the corresponding parts in Camponotus. Anterior femora incrassated. Head elongate, subtrapezoidal, with long, straight or more or less convex or inflated cheeks. Eyes very large, prominent, elliptical and finely facetted, at the posterior corners of the head. Ocelli usually absent, the anterior ocellus sometimes present. Mandibles small, triangular, 5-toothed. Maxillary palpi 6-jointed, labial palpi 4-jointed. Clypeus well-developed, more or less carinate or subcarinate, its anterior border entire, projecting over the base of the mandibles as a broad, rather rounded lobe. Antennae 12-jointed, inserted at the sides of the frontal carinae some distance behind the posterior clypeal suture, so that the antennal and clypeal fossae are distinctly separated. Antennal funiculi nonclavate, all the joints distinctly longer than broad. Frontal area large, indistinct, subtriangular or trapezoidal; frontal carinae moderately long, rather far apart, diverging posteriorly. Epinotum unarmed, more or less angular. Petiolar scale thin and anteroposteriorly compressed. Proventriculus long and slender, the calyx straight, with nonreflected sepals. Body smooth, more or less shining, finely shagreened. Pilosity and pubescence feebly developed.

Female. Larger than the worker, with broader head and usually 6-toothed mandibles. Eyes and ocelli well-developed, the former much as in the worker. Thorax, petiole, and gaster as in Camponotus, the thorax elongate elliptical, the petiole anteroposteriorly compressed. Wings also similar but with small but distinct, triangular discal cell.

Male. Not larger than the worker, very similar to the male of Camponotus. Maxillary palpi 6-jointed, labial palpi 4-jointed. Mandibles well-developed, pointed, usually edentate. Eyes and ocelli large, the former nearly half as long as the head; cheeks long and straight. Antennae 13-jointed, scapes fully $\frac{2}{3}$ as long as the funiculi; first joint of the latter cylindrical, scarcely longer but distinctly thicker than the second. Thorax, petiole, and gaster much as in Camponotus; the external genitalia also very similar, their valves slender and exserted. Wings with the discal cell very small and triangular, sometimes wanting.

Table for the identification of the workers.

1. Head largely black or dark brown........................2
   Head entirely yellow or with only the vertex and occiput black.10
2. Thorax black or dark brown, without yellow markings.......3
   Thorax wholly or in part yellow..........................5
3. Head and body very slender, subopaque, and sharply shagreened. Length 6 mm...........................*maurus*, sp. nov.
   Head and body shorter, shining. Length 3–5 mm...........4
4. Thorax and first gastric segment brown......*lienosus*, sp. nov.
   Upper portion of first gastric segment ivory yellow.
   respiciens Sm. var. *moestus*, sp. nov.
5. Thorax and legs partly black.............................6
   Thorax and legs entirely yellow..............*rufithorax Emery*.
6. Yellow of thorax of a whitish or ivory tint....*respiciens* Smith.
   Pale portions of thorax orange-yellow.....................7
7. Epinotum more or less yellow above........................8
   Epinotum black...9
8. Pro- and mesoëpinotum yellow above an oblique line running from the ventral border of the pronotum to the epinotal angle.
   pictus Emery.
   Only the ventral portion of the meso- and epinotum black.
   pictus var. *palliatus*, var. nov.
9. Only the pronotum yellow....*pictus* var. *bimaculatus*, var. nov.
   Both the pro- and mesonotum yellow above.
   pictus var. *lepidus*, var. nov.
10. Pronotum with a conspicuous arc of erect hairs; epinotum low and bluntly angular..........................*major* Forel.
    Pronotum without erect hairs; epinotum higher and more sharply angular....................................11
11. Gaster entirely black...........*haddoni* subsp. *rufoniger* Forel.
    Gaster more or less yellow...............................12

12. Gaster entirely or almost entirely yellow..................15
Gaster black at least behind the second segment............13
13. Head entirely yellow........................*haddoni* Emery.
Vertex and occiput black..............................14
14. Second gastric segment yellow only at the base.
diadematus, sp. nov.
Second gastric segment entirely yellow.
diadematus var. *dubius*, var. nov.
15. Third and fourth gastric segments with black markings on the sides; workers dimorphic, minor worker with infuscated vertex and occiput.......................*jocosus*, sp. nov.
Gaster entirely yellow or with only the anal segment blackened; workers monomorphic, head of small workers not infuscated behind..16
16. Body shining, very indistinctly shagreened. Length 3–4.5 mm.
manni, sp. nov.
Body opaque, sharply shagreened. Length 5.8 mm.
linnaei Forel.

1. Opisthopsis respiciens (F. Smith).

Plate **1**, fig. 1, 2.

Formica (*Myrmecopsis*) *respiciens* F. Smith, Journ. Linn. soc. Zool., 1864, **8**, p. 68, ☿, pl. 4, fig. 3, 3a.

Myrmecopsis respiciens Mayr, Journ. Mus. Godeffroy, 1876, **12**, p. 76, ☿.

Opisthopsis (*Myrmecopsis*) *respiciens* Forel, Ann. Soc. ent. Belg., 1893, **37**, p. 461, ☿ ♀.

Opisthopsis respiciens Emery, in Dalla Torre, Cat. Hymen., 1893, **7**, p. 219, ☿; Emery, Ann. Soc. ent. Belg., 1895, **39**, p. 353; Emery, Mem. R. accad. sci., ist. Bologna, 1896, ser. 5, **5**, p. 776; Froggatt, Agric. gaz. N. S. W., 1905, p. 28, ☿; Forel, Ergeb. Hamb. S. W. Austr. Forschungsreise, 1907, **1**, p. 229, ☿; Viehmeyer, Abh. ber. K. zool. anthr. ethn. mus. Dresden, 1912, **14**, p. 23.

Worker. Length 3–4.5 mm.

Head evenly convex dorsally and ventrally, with straight posterior margin and evenly convex sides, which converge anteriorly in the region of the cheeks. Eyes large and prominent, rather close together. Mandibles 5-toothed, with convex external borders. Clypeus distinctly carinate. Profile outline of mesonotum and base of epinotum forming a straight horizontal line, scarcely interrupted at the meso-ëpinotal suture. Base and declivity of epinotum subequal, the latter sloping and concave, forming a well-defined obtuse angle with the base. Petiole oval, broader above than below, a little higher than broad, with broadly rounded, entire and sharp superior border, in profile thin and anteroposteriorly compressed, convex in front above, flat behind, nearly or quite as high as the epinotal angle.

Shining; head and thorax sharply and finely, gaster and legs more indistinctly and more superficially shagreened. Mandibles and clypeus subopaque, the former also sparsely punctate.

Hairs pale yellow, very sparse, erect, present only on the head and gaster, tips of the femora and antennal scapes. Pubescence absent, except on the antennae, where it is extremely fine.

Black; upper portion of pronotum and first gastric segment and extreme base of second gastric segment, sometimes as two blotches, ivory-yellow; mandibles, cheeks, more or less of the anterior portion of the clypeus, the antennal scapes, tibiae, tarsi, tips of femora, and base of petiole brownish yellow. Palpi, first funicular joint, articulations of thorax, borders of gastric segments and sometimes also the mesonotum brown. Eyes pearl-gray.

NEW GUINEA, type-locality (F. Smith). QUEENSLAND: Rockhampton and Peak Downs (Museum Godeffroy); Cairns and Kuranda (Wheeler). N. W. AUSTRALIA: Adelaide River and Baudin Islands (J. J. Walker). NEW SOUTH WALES: Sydney (Museum Godeffroy).

I have been unable to find this ant in New South Wales so that I doubt its occurrence at Sydney. Mayr applied the name *respiciens* to several species of Opisthopsis, so that even his localities Rockhampton and Peak Downs, Queensland, may refer to some other species. In the neighborhood of Cairns and Kuranda, the typical *respiciens* is not uncommon, running on the trunks of large Eucalyptus and Melaleuca trees along paths and in clearings in the tropical "scrub," in company with workers of various species of Camponotus, Calomyrmex, Polyrhachis, and Podomyrma. I was unable to find its nests or to secure male and female specimens.

2. OPISTHOPSIS RESPICIENS var. MOESTUS, var. nov.

Worker. Differing from the typical *respiciens* in having the pronotum entirely black or dark brown above and the dark dorsal portion of the petiole and of the cheeks more extensive. The pale ivory-yellow area at the base of the second gastric segment is also more restricted. The epinotal angle seems to be somewhat more acute in profile than in the typical form.

Female (deälated). Length 10 mm.

Head a little longer than broad, with straight, anteriorly converging sides and slightly convex posterior border. Eyes proportionally smaller than in the worker. Ocelli small. Thorax elongate elliptical, a little narrower through the wing-insertions than the head through the eyes. Epinotum in profile with very short, convex base and long, abruptly sloping declivity, concave below. Petiolar border feebly emarginate in the middle. Gaster large, broadly elliptical, somewhat flattened dorsoventrally.

Pilosity and sculpture as in the worker.

Black; apical half of mandibles, antennal scapes, wing-insertions, and tarsi dark brown; tibiae and apical fourth of femora brownish red. Eyes black.

Male. Length nearly 5 mm.

Slender; head through the eyes as broad as long; eyes large, convex, nearly circular, as long as the cheeks, which are straight and converge anteriorly. Mandibles small, edentate, with acute tips. Clypeus convex, carinate. Antennae slender; scapes as long as the basal seven joints of the funiculus; first funicular joint as long as the second but broader, remaining joints subequal, more than twice as long as broad. Thorax not broader than the head through the eyes; mesonotum as long as broad, convex in front and overarching the pronotum. Epinotum with subequal base and declivity, the former convex, the latter straight and vertical in profile. Petiole cuneate in profile, with concave posterior surface, its superior margin sharp and distinctly and rather broadly notched in the middle. Gaster slender, elongate elliptical, with small genital appendages. Legs slender. Wings without a discal cell.

Sculpture as in the worker.

Hairs short, delicate, pale, more abundant than in the worker and as numerous on the thorax as on the gaster.

Black; knees, tips of tibiae, and tarsi piceous. Wings yellowish hyaline, with pale yellow veins and pterostigma. Eyes dark brown.

QUEENSLAND: Townsville, type-locality (F. P. Dodd); Cairns (Wheeler).

Described from one female, one male, and four workers taken by F. P. Dodd and belonging to the Museum of South Australia. The workers of this series agree perfectly with numerous specimens taken by myself at Cairns, running on tree-trunks with the typical *respiciens.*

3. OPISTHOPSIS MAURUS, sp. nov.

Plate **3**, fig. 18, 19.

Worker. Length 6 mm.

Body long and slender; head $\frac{1}{4}$ longer than broad, flattened dorsally and ventrally, with long, straight, anteriorly converging sides and distinctly concave posterior border. Eyes large and prominent. Mandibles 5-toothed, their external borders rather straight. Clypeus distinctly carinate. Antennal scapes extending only a short distance beyond the posterior orbits. Thorax slender and low, its dorsal outline in profile straight and horizontal, very feebly interrupted at the promesonotal and mesoëpinotal sutures. Epinotum with distinct but rounded obtuse angle between the subequal base and declivity. Petiole with semicircular, entire superior border, compressed anteroposteriorly, feebly convex in front, flat behind. Gaster long and narrow, with pointed tip and the anterior surface of the basal segment scarcely truncated.

Subopaque; densely and sharply shagreened; head and gaster with small, scattered, piligerous punctures; mandibles more densely and more coarsely punctate; surface of clypeus uneven.

Hairs pale grayish, sparse, present only on the head and gaster and on the tips of the femora and antennal scapes.

Black; knees, tips of tibiae, bases of mandibles, and eyes dark brown.

Described from a single specimen taken at Koah, Queensland, in a nest of *O. haddoni* occupying the basal galleries of a conical termitarium. The specimen is so different in shape, sculpture, and color from the workers of *haddoni* and from all of the other members of the genus that I believe it must represent a distinct species. It had probably been reared from a larva or pupa kidnapped and brought into the nest by the *haddoni* workers.

4. OPISTHOPSIS PICTUS Emery.

Plate **3**, fig. 27.

Opisthopsis pictus Emery, Ann. Soc. ent. Belg., 1895, **39**, p. 354, ☿ fig. 3B.; Emery, Mem. R. accad. sci. ist. Bologna, 1896, ser. 5, **5**, p. 776; Froggatt, Agric. gaz. N. S. W., 1905, p. 28.

Worker. Length 4–5 mm.

Head rather flat dorsally and ventrally, twice as long as high, with large, prominent eyes and feebly concave posterior border, its sides feebly convex in large workers, straight in small individuals. Mandibles 5-toothed, with rather straight external borders. Clypeus distinctly carinate behind. Thorax evenly compressed laterally in the epinotal region, base of the latter in profile straight and horizontal, scarcely impressed at the mesoëpinotal suture; base and declivity meeting at a sharp obtuse angle, the declivity abruptly sloping and concave. Petiolar scale slightly thinner and lower than in *respiciens*, its anterior and posterior surfaces flat, the former convex above where it meets the rounded, entire and rather sharp superior border. Gaster elongate elliptical, of the usual shape, with the anterior surface of the first segment truncated.

Rather shining; head more opaque and more sharply shagreened; gaster very finely and transversely striolate, with silky luster; mandibles coarsely punctate and somewhat striate near their apical borders.

Hairs sparse, whitish, erect, blunt, most numerous on the head and gaster; thorax and petiole without hairs, except a few on the dorsal surface of the pronotum.

Head black, with the mandibles and anterior border of the cheeks and clypeus lemon-yellow. Antennal scapes orange-yellow; funiculi black, in some specimens with the first joint brown or yellowish. Palpi black. Pronotum and dorsal portions of mesonotum and epinotum above an oblique line on each side running from the inferior border of the pronotum to the epinotal angle, orange-yellow; below this line and including the prosternum, black. Scale of petiole brown or blackish, its basal portion yellow. Gaster black, first and second segments orange-yellow, with the sides more or less infuscated or black. Coxae, trochanters, and basal $\frac{2}{3}$ of femora black, remainder of femora and tibiae orange-yellow; tarsi more brownish. The yellow of the legs and gaster is distinctly paler than that of the thorax. Eyes black in some specimens, in others pearl-gray.

QUEENSLAND: Kamerunga, type-locality (Podenzana); Townsville (F. P. Dodd); Nelson (A. A. Girault).

I have redescribed this form from four workers taken by F. P. Dodd and belonging to the Museum of South Australia. With the exception of a single worker taken by Girault at Nelson, all the other specimens of the species in my collection belong to the three following undescribed varieties.

5. OPISTHOPSIS PICTUS var. PALLIATUS, var. nov.

Plate **3**, fig. 28.

Worker. Differing from the typical *pictus* in color, the black of the thorax being restricted to the lowermost portions of the meso- and epinotum. Some specimens have the prosterna black. The black of the femora does not extend beyond their basal third or half. The petiolar scale is only slightly infuscated at the superior border. The first two gastric segments are orange-yellow, only a little paler than the thoracic dorsum and there is a large brown spot on each side of the second segment. Eyes pearl-gray.

QUEENSLAND: Sunnybank, near Brisbane, type-locality (Wheeler); Mungar Junction (A. M. Lea).

This variety is distinctly transitional to *O. rufithorax* Emery.

6. OPISTHOPSIS PICTUS var. LEPIDUS, var. nov.

Plate **1**, fig. 3, 4.

Worker. Differing from the preceding forms in the color of the thorax. Only the pronotum and dorsal portion of the mesonotum are orange-yellow, the remainder black. Even the lower border of the pronotum is black in some specimens. Legs and gaster as in the typical *pictus,* though some specimens have the posterior portion of the second segment black or the yellow reduced to a large bilobed spot at the anterior border of the segment. First funicular joint as black as the succeeding joints. Eyes pearl-gray. The epinotal angle is very sharp in many specimens and the concavity of the declivity even more abrupt than in the figure 3.

QUEENSLAND: Townsville, type-locality, Kuranda, Koah, and Sunnybank, near Brisbane (Wheeler); Mackay (Turner).

7. OPISTHOPSIS PICTUS var. BIMACULATUS, var. nov.

Worker. Length 5 mm.

Larger and more robust than the preceding forms, with the sides of the head distinctly more convex. The orange-yellow color is still further restricted on the thorax and confined to the dorsal portion of the pronotum. Petiole entirely black. Only the dorsal portion of the first gastric segment and two large, sharply defined, elliptical spots on the base of the second segment are orange-yellow, just perceptibly paler than the pronotum. The femora are black, with only their tips reddish, the tibiae reddish brown. Mandibles and anterior corners of cheeks red. Eyes pearl-gray.

Described from a single specimen found running on one of the white-trunked Eucalyptus trees on the mountain west of Townsville, Queensland.

8. OPISTHOPSIS RUFITHORAX Emery.

Plate **1**, fig. 5, 6.

Opisthopsis rufithorax Emery, Ann. Soc. ent. Belg., 1895, **39**, p. 354, ☿, fig. 3A.; Emery, Mem. R. accad. sci. ist. Bologna, 1896, ser. 5, **5**, p. 776; Froggatt, Agric. gaz. N. S. W., 1905, p. 28, ☿; Forel, Ark. f. zool., 1915, **9**, p. 95, ☿ ♀.

Worker. Length 4–5 mm.

Very similar to *pictus* in structure, but with the dorsal outline of the thorax in profile a little more rounded and the epinotum slightly lower and with a somewhat more rounded angle.

Sculpture and pilosity as in *pictus*.

Color of head and antennae as in *pictus;* thorax, legs, and petiole orange-yellow throughout, last tarsal joint blackish or dark brown. Gaster black, with the first two segments either entirely orange-yellow, of a slightly paler tint than the thorax, or with the sides of these segments and the posterior portion of the second blackish.

Female. Length 7–10 mm.

"Head behind broader than in the worker, cheeks not convex. Thorax as broad as the head. Occiput, vertex and funiculus brown. Scutellum and a narrow but clearly defined transverse band on each gastric segment black. All the remainder of the body yellowish red, only the middle of the pronotum infuscated. Wings lacking. In all other respects like the worker." (Forel).

QUEENSLAND: Peak Downs, type-locality (Museum Godeffroy); Atherton and Cedar Creek (E. Mjöberg); Enoggera and Sunnybank, near Brisbane (Wheeler); Gayndah, Bundaberg, and Mungar Junction (A. M. Lea); Cairns (F. P. Dodd). NEW SOUTH WALES: Manilla (W. W. Froggatt). SOUTH AUSTRALIA: Moorooloo, Flinders Range (S. A. White). WEST AUSTRALIA: Mullewa (Miss F. May); Clarence River (A. and F. Zietz).

This form is so close to *pictus* that it might properly be regarded as a subspecies or variety of that species. The specimens which I took at Enoggera and Sunnybank were running about on Eucalyptus trunks and on the ground. Mjöberg found the species nesting in clay about the roots of trees at Atherton and Cedar Creek.

9. OPISTHOPSIS HADDONI Emery.

Plate **2**, fig. 11–16; Plate **3**, fig. 29.

Opisthopsis haddoni Emery, Rev. Suisse zool., 1893, **1**, p. 226, ☿; Emery, Mem. R. accad. sci. ist. Bologna, 1896, ser. 5, **5**, p. 776; Froggatt, Agric. gaz. N. S. W., 1905, p. 28; Viehmeyer, Abh. ber. K. zool. anthr. ethn. mus. Dresden, 1912, **14**, p. 23; Forel, Ark. f. zool., 1915, **9**, p. 95, ☿; Crawley, Ann. mag. nat. hist., 15, 1915, ser. 8, **15**, p. 135, ☿.

Worker. Length 3–5.5 mm.

Head evenly convex dorsally and ventrally, with straight posterior border, in large workers with very feebly convex, in small workers with straight sides. Mandibles 5-toothed, their external borders rather straight. Clypeus carinate at the base. Thorax and petiole shaped much as in *rufithorax,* the former rather short, with blunt epinotal angle.

Shining; head and thorax more opaque than the gaster and more distinctly shagreened. Mandibles shining, sparsely punctate.

Hairs whitish, sparse, erect, blunt, absent on the thorax and petiole.

Clear orange-yellow, vertex and occiput of head a little darker, cheeks, clypeus, and mandibles more lemon-yellow, the teeth of the mandibles brown. Gastric segments behind the second, palpi, and funicular joints, except the first, black. Terminal tarsal joints brown or reddish. Eyes black.

Female. Length 8–9 mm.

Head shaped like that of the worker but a little broader, a little narrower than the thorax through the wing-insertions, with nearly straight sides. Mandibles 6-toothed. Mesonotum as broad as long, epinotum with distinct base and declivity, the former short and convex, the latter vertical and concave in profile. Petiole as in the worker, but with its superior border feebly notched in the middle. Gaster rather large, elongate elliptical. Wings moderately long, with well-developed, triangular discal cell.

Sculpture and pilosity as in the worker, except that the head and thorax are as smooth and shining as the gaster.

Color like that of the worker, but with the scutellum and metanotal sclerite black and the wing-insertions dark brown. Wings yellowish hyaline, with pale brown veins and pterostigma. Eyes black.

Male. Length 4–4.5 mm.

Head through the eyes as broad as long, with straight, anteriorly converging cheeks as long as the eyes. Mandibles small, with acute tips and oblique, edentate apical borders. Clypeus ecarinate. Frontal carinae short. Antennae slender; scapes as long as the seven basal joints of the funiculus; first funicular joint as long as the second but thicker; all the funicular joints subequal, more than twice as long as broad. Thorax through the mesonotum a little broader than the head through the eyes, convex and prominent in front. Epinotum very convex, sloping, without distinct base and declivity. Petiole lower and thicker than in the worker, cuneate in profile, its superior border rather blunt and rather deeply and angularly notched in the middle. Gaster slender, with small, slender, exserted genitalia. Legs slender. Wings with small, triangular discal cell.

Shining and distinctly shagreened; head rather opaque above; mesonotum sparsely and coarsely punctate.

Pilosity as in the worker, but with short, sparse erect hairs also on the mesonotum.

Black; antennae piceous brown; mandibles, corners of the cheeks, mouthparts, legs, and wing-insertions yellowish brown, the middle portions of the femora darker. Wings grayish hyaline, with pale brown veins and pterostigma. Eyes pearl-gray.

MURRAY ISLANDS: Torres Strait, type-locality (A. C. Haddon). QUEENSLAND: Townsville (W. W. Froggatt); Laura, Cape York, and Colosseum (E. Mjöberg); Koah, Kuranda, and Townsville (Wheeler); Cairns (A. M. Lea). NORTHERN TERRITORY: Point Charles (G. F. Hill); Daly River (H. Wesselmann); Melville Island (F. P. Dodd). CENTRAL AUSTRALIA: Tennant's Creek (J. F. Field). NORTH WEST AUSTRALIA: Broome, Kimberley District (E. Mjöberg).

Redescribed from a worker cotype and numerous specimens of all three phases taken by myself in termite nests at Koah, Kuranda, and Townsville. Dr. E. Mjöberg had previously observed its occurrence in these structures. More rarely it nests under stones without relations to termites. The winged sexual phases were found in the nests October 31 to November 6. The species is evidently widely distributed over tropical Australia and will probably be found in New Guinea.

10. Opisthopsis haddoni subsp. rufoniger Forel.

Plate **2**, fig. 17.

Opisthopsis haddoni race *rufoniger* Forel, Rev. Suisse zool., 1910, **18**, p. 70, ☿.

Worker. Length 3–7 mm.

Differing from the worker of the typical *haddoni* in the more acutely angular epinotum, in having the superior border of the petiolar scale feebly emarginate in the middle, in the color of the gaster, which is entirely black, and of the antennal funiculi, the basal third or half of which is brownish or yellowish. Eyes pearl-gray, brown or black.

Female (deälated). Length 8 mm.

Differing from the female *haddoni* in having the entire gaster black and the base of the funiculus brown, but the metanotum and scutellum are orange-yellow, the latter with brown spots. Eyes pearl-gray.

Male. Length 3 mm.

Smaller than the male of *haddoni* and with the body dark brown instead of black (possibly due to immaturity or prolonged immersion in alcohol). The head seems to be shorter, the wings are more opaque. Eyes pale brown.

Central Australia: Tennant's Creek, type-locality (J. F. Field).

Redescribed from numerous workers, a single female and three males belonging to the cotype series and loaned me by the Museum of South Australia.

11. Opisthopsis lienosus, sp. nov.

Plate **2**, fig. 9, 10.

Worker. Length 4–5 mm.

Closely related to *haddoni.* Sides of head feebly convex, rather strongly converging in front, posterior border straight or very feebly convex. Eyes moderately large. Mandibles 5-toothed, with convex external borders. Clypeus distinctly carinate. Thorax with rather sharp mesoëpinotal angle and the promesonotal and mesoëpinotal sutures slightly but distinctly impressed. Petiolar scale thin, its upper border rounded, straight in the middle and in some specimens feebly impressed. Gaster and legs of the usual structure.

More shining than *haddoni,* very finely shagreened, upper surface of head with a silky luster. Mandibles shining, sparsely punctate.

Pilosity as in *haddoni*, lacking on the thorax and petiole.

Black; sides and anterior portion of head, thorax, coxae, petiole, first gastric segment and in some specimens the extreme base of the second, castaneous brown. Antennal scapes, first funicular joint and legs yellowish brown, femora darker in the middle. Mandibles yellow, with black teeth. Eyes pearl-gray.

Described from eight specimens taken in three colonies of *O. haddoni* at Koah, Queensland, October 29. Like the specimen of *O. maurus*, they had probably been reared from kidnapped larvae or pupae.

12. OPISTHOPSIS DIADEMATUS, sp. nov.

Plate **3**, fig. 20, 21.

Worker. Length 4–5 mm.

Head very convex dorsally, ventrally and laterally, so that the cheeks have a swollen appearance. Posterior border straight. Eyes rather small and far apart. Mandibles with slightly convex external borders, the apical borders not very oblique, their five teeth small and subequal. Clypeus broader than long, indistinctly carinate. Thorax rather robust, with well-marked promesonotal and mesoëpinotal sutures; the base and declivity of the epinotum subequal, the former slightly concave, the latter abruptly sloping and concave, the angle between them blunt but prominent. Petiolar scale of the usual shape, nearly as high as the epinotal angle. Gaster rather large.

Shining, very finely shagreened and sparsely and finely punctate; mandibles more coarsely punctate.

Hairs pale yellow, sparse, erect; absent on the thorax and petiole.

Orange-yellow, head not paler in front; funiculi, except their basal joint, space between the eyes and including the vertex and occiput, gastric segments behind the second, all but the base of the second above and in some specimens a spot on each side of the first segment, black. Posterior borders of gastric segments pale brown. The yellow of the anterior gastric segments is distinctly paler than that of the legs. Palpi dark brown. Eyes dark brown or black.

Described from seven workers taken at Townsville, Queensland, on the bark of Eucalyptus trees and undoubtedly belonging to several colonies.

13. OPITHOPSIS DIADEMATUS var. DUBIUS, var. nov.

Worker. Length 4.5 mm.

Differing from the typical *diadematus* in having the head more flattened as in *rufithorax* and in having the second gastric segment entirely orange-yellow above.

A single specimen taken by Mr. A. M. Lea at Longreach, Queensland. Perhaps this form should be regarded as a variety of *rufithorax*, and perhaps *diadematus* should be regarded as a subspecies of that form. The head of the new variety is certainly intermediate in shape between the two, though its coloration is that of *diadematus*.

14. OPISTHOPSIS MAJOR Forel.

Plate **1**, fig. 7, 8.

Opisthopsis major Forel, Rev. Suisse zool., 1902, **10**, p. 492, ☿; Froggatt, Agric. gaz. N. S. W., 1905, p. 28, ☿; Forel, Rev. Suisse zool., 1910, **18**, p. 70, ☿.

Worker. Length 4.5–7 mm.

Averaging larger than most of the preceding species. Head rather broad, evenly convex above and below, with convex sides, straight posterior border and rather small eyes. External borders of the 5-toothed mandibles convex. Clypeus broader than long, indistinctly carinate. Funicular joints a little shorter than in the preceding species. Thorax with the epinotum decidedly lower, so that the outline of the mesonotum and base of the epinotum, though forming a straight line, slopes backwards; base and declivity of epinotum subequal, forming a rounded and very obtuse angle. Petiole of the usual shape, its scale as high as the epinotal angle. Gaster and legs of the usual shape.

Shining, very finely and indistinctly shagreened and very finely and sparsely punctate. Mandibles coarsely shagreened and punctate.

Hairs yellow, erect, sparse on the head and gaster, absent on the thorax and petiole, except on the pronotum where they form a conspicuous tuft arranged in a semicircle. Pubescence almost absent, very short and dilute on the sides of the head.

Orange-yellow; mandibular teeth brown; antennal funiculi, except their basal joint, gaster behind the second segment, posterior half or two thirds of the second segment and a narrow transverse band near the posterior margin of the first segment, black or dark brown. Eyes pearl-gray or black.

Female. Length 8–8.5 mm.

Head like that of the worker, but a little shorter. Mandibles 5-toothed. Thorax elongate elliptical, through the wing-insertions not broader than the head through the eyes. Mesonotum distinctly broader than long. Epinotum with distinct base and declivity, the former short and convex, the latter long, abruptly sloping and concave in profile. Petiolar scale with very feebly emarginate superior border. Gaster elliptical, as long as the thorax. Wings rather short (7 mm.), with a well-developed, triangular discal cell.

Sculpture and pilosity as in the worker, but mesonotum and scutellum smoother and more shining, pronotum without hairs and mesonotum sparsely hairy.

Color like that of the worker but with the scutellum and middle of the metanotal sclerite black. Wings distinctly tinged with yellow, especially towards the base, with resin-yellow veins and pterostigma. Eyes black.

QUEENSLAND: Mackay, type-locality (Turner); Cape York; Townsville (F. P. Dodd); Rockhampton (A. M. Lea).

I have examined two cotype workers received from Professor Forel, four workers and a female taken by Mr. Dodd and a worker taken by Mr. Lea.

This species is very distinct in its average large size, in the structure of the epinotum of the worker, the conspicuous tuft of hairs on the pronotum and the color of the gaster. In Fig. 7 the epinotal angle is too sharp and the base and declivity should be more nearly equal. The head, represented in Fig. 8, is a little too broad.

15. OPISTHOPSIS JOCOSUS, sp. nov.

Plate **3**, fig. 22–24.

Worker. Length 4–6.5 mm.

Head of the largest workers large and very broad through the middle, with very convex sides and feebly concave posterior border, narrowed at the anterior border; in profile evenly convex above and below; in the smallest workers the head is narrow, with straight sides and more concave posterior border and its dorsal and ventral surfaces are less convex. Eyes far apart, relatively larger in the small workers. Mandibles with feebly concave external borders, 5-toothed. Clypeus broader than long, rather flat, ecarinate. Thorax with the pronotum convex behind, the dorsal outline of the mesonotum and base of epinotum continuous and very straight, the base and declivity of the epinotum subequal, forming a sharp angle. Petiolar scale much compressed anteroposteriorly, not quite as high as the epinotal angle, with sharp, entire and rounded superior border. Gaster and legs of the usual shape.

Only moderately shining, finely shagreened, gaster more sharply and transversely and with a silky luster. Mandibles shining, finely punctate.

Hairs yellow, short, sparse, erect, absent on the thorax and petiole. Pubescence distinct, but very short and dilute on the cheeks and sides of the head.

Dull brownish yellow; palpi brown; funiculi, except the basal joint, and anal segment of gaster black; second, third, and fourth gastric segments with a narrow black spot of variable extent near the ventral margin on each side. Small workers with the space between the eyes dark brown. Sometimes this area is reduced to three ocellus-like spots with vague outlines.

Described from numerous specimens taken in a piece of dry woodland near the Baron Falls at Kuranda, Queensland from a single colony evidently hunting for the brood of an Iridomyrmex nest which I had excavated in the soil a few hours previously. *O. jocosus* is a very distinct form not only in the peculiar shape of the head of the larger worker, the shape of the epinotum and the coloration of the gaster but also in having clearly dimorphic workers.

16. OPISTHOPSIS LINNAEI Forel.

Opisthopsis linnaei Forel, Mitth. Zool. mus. Berlin, 1901, **2**, p. 26, ☿; Dahl, Leben d. ameis. Bismarck Archip., 1901, p. 42; Viehmeyer, Abh. ber. K. zool. anthr. ethn. mus. Dresden, 1912, **14**, p. 23.

Worker. Length 5.8 mm.

"Closely related to *O. haddoni*, but entirely opaque, including the mandibles and legs; only the head anteriorly and on the sides, shining. The striated and reticulated sculpture is deeper, sharper and microscopically uneven. The sides of the rather elongated head are less convex (very feebly convex). Gaster entirely yellow (in *haddoni* the posterior half is black). In other respects like *haddoni* but the color is less vivid, more of a dirty, rusty yellow." (Forel).

BISMARCK ARCHIPELAGO: Ralum (Fr. Dahl).

I have not seen this species, which Forel described from two specimens so badly damaged that he could not determine the form of the thorax. According to Dahl, it nests in rotten portions of tree-trunks. It seems to be rather closely related to the following species.

17. OPISTHOPSIS MANNI, sp. nov.

Plate **3**, fig. 25, 26.

Worker. Length 3–4.5 mm.

Smaller than the preceding species. Head long, with straight, anteriorly converging sides, straight posterior border and large, prominent eyes. Mandibles 5-toothed, with rather convex external borders. Clypeus broader than long, subcarinate. Thorax shaped much as in *O. haddoni*, the base and declivity of the epinotum subequal, the former straight and horizontal, the latter abruptly sloping and concave, the angle between very distinct but slightly rounded. Petiolar scale apparently a little thicker than in most species of the genus, its superior border not so high as the epinotal angle, straight and transverse in the middle. Gaster and legs of the usual shape.

Smooth and shining, not distinctly shagreened, the head and mandibles slightly more opaque than the thorax and gaster, the mandibles with fine, scattered and indistinct punctures.

Hairs sparse, yellow, erect and rather short, absent on the thorax and petiole. Pubescence absent.

Clear orange-yellow; cheeks, clypeus, and mandibles paler and more lemon-yellow; anal segment, last tarsal joint and funiculi, with the exception of the first joint, black. Palpi yellowish. Eyes pearl-gray.

Female (deälated). Length 6.5 mm.

Very similar to the worker; head a little broader, broader than the elongate elliptical thorax. Petiolar scale with entire, rounded superior border.

Sculpture, pilosity, and color as in the worker, except that the scutellum is black.

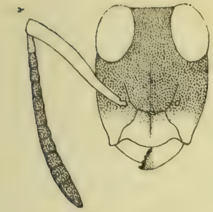
Described from several workers and a female from Malapaina (type-locality) and several workers from Malaita and Yandina, British Solomon Islands. These specimens were recently taken by Dr. W. M. Mann, who writes me as follows concerning their habits: "The only note I have on the Malapaina specimens of Opisthopsis is that they were nesting beneath bark in a depression on the trunk of a recently felled tree. The colony was composed of only a couple of dozen workers and one female. The workers made no attempt to save any of the few larvae that were in the nest. The specimens from Malaita and Yandina were found running on tree-trunks. The species is evidently very widely distributed in the Solomons but is rarely seen, probably because of its arboreal habits. It is very active and difficult to catch."

EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

Fig. 1. *Opisthopsis respiciens* (F. Smith). Worker.
Fig. 2. Head of same.
Fig. 3. *Opisthopsis pictus* Emery var. *lepidus* Wheeler. Worker.
Fig. 4. Head of same.
Fig. 5. *Opisthopsis rufithorax* Emery. Worker.
Fig. 6. Head of same.
Fig. 7. *Opisthopsis major* Forel. Worker.
Fig. 8. Head of same.



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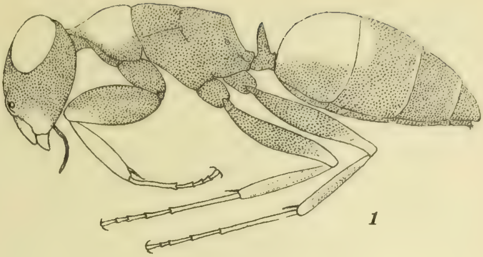

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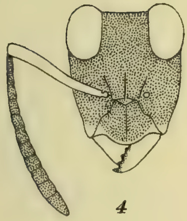

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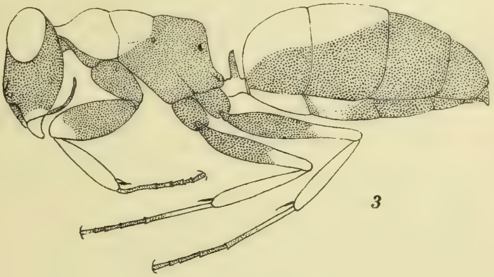

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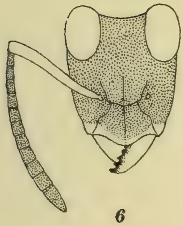

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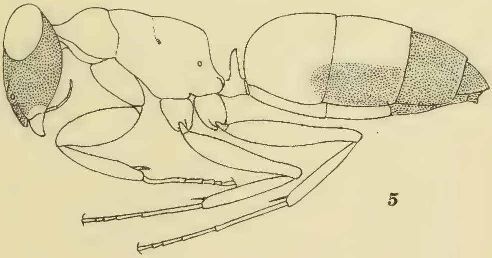

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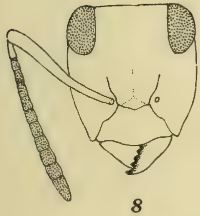

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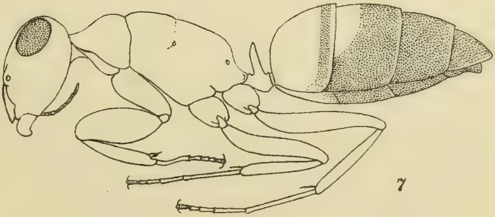

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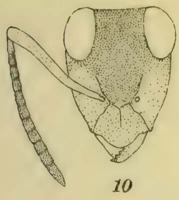
PLATE 2.

PLATE 2.

Fig. 9. *Opisthopsis lienosus* Wheeler. Worker.
Fig. 10. Head of same.
Fig. 11. *Opisthopsis haddoni* Emery. Worker.
Fig. 12. Head of same.
Fig. 13. *Opisthopsis haddoni* Emery. Female.
Fig. 14. Head of same.
Fig. 15. Fore wing of same.
Fig. 16. *Opisthopsis haddoni* Emery. Head of male.
Fig. 17. *Opisthopsis haddoni* subsp. *rufoniger* Forel. Worker.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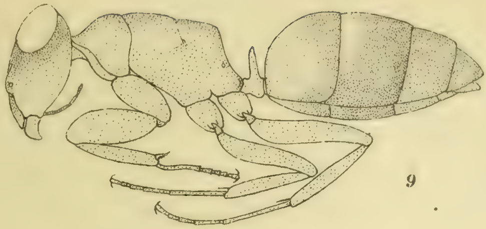
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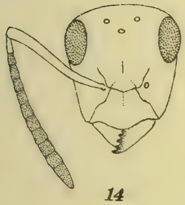
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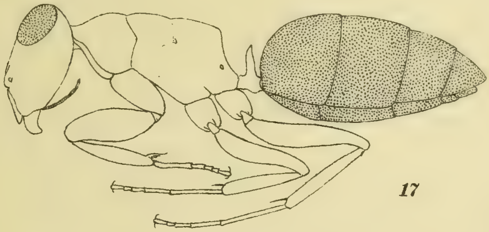
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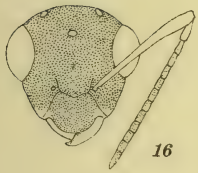
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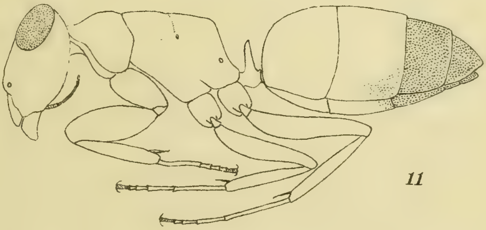
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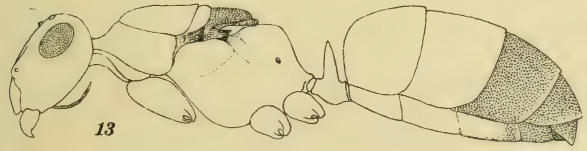
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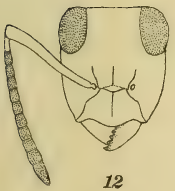
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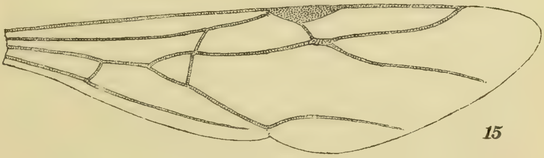
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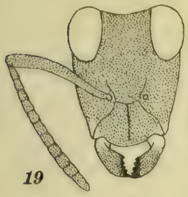
HELIOTYPE CO. BOSTON

PLATE 3.

PLATE 3.

Fig. 18. *Opisthopsis maurus* Wheeler. Worker.
Fig. 19. Head of same.
Fig. 20. *Opisthopsis diadematus* Wheeler. Worker.
Fig. 21. Head of same.
Fig. 22. *Opisthopsis jocosus* Wheeler. Worker major.
Fig. 23. Head of same.
Fig. 24. Head of worker minor of same.
Fig. 25. *Opisthopsis manni* Wheeler. Worker.
Fig. 26. Head of same.
Fig. 27. *Opisthopsis pictus* Emery. Thorax of worker.
Fig. 28. *Opisthopsis pictus* var. *palliatus* Wheeler. Thorax of worker.
Fig. 29. *Opisthopsis haddoni* Emery. Proventriculus ("gizzard").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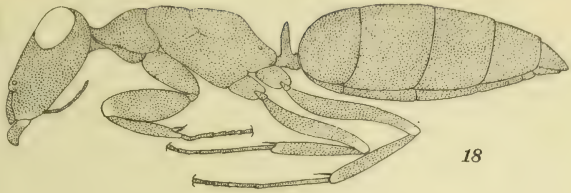
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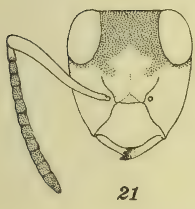
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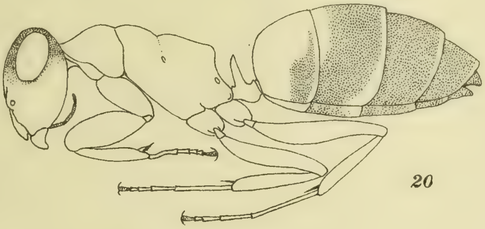
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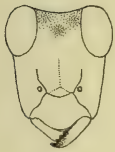
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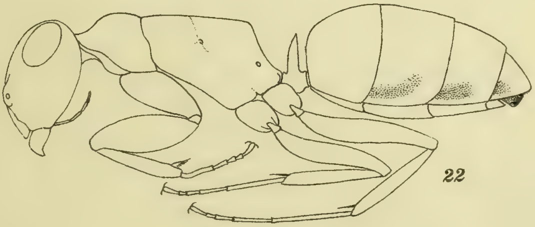
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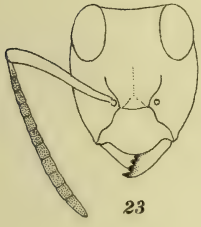
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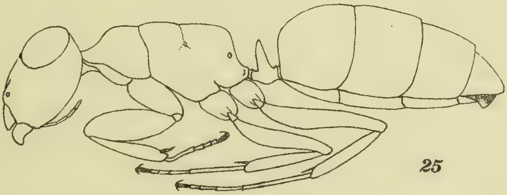
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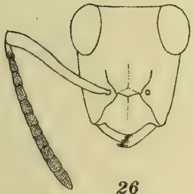
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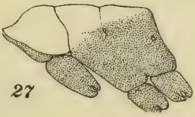
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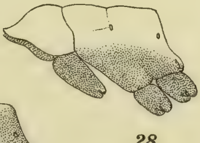
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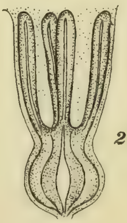
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A. E. VERRILL. The Alcyonaria of the "Blake."

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O. CARLGREN. The Actinarians.
R. V. CHAMBERLIN. The Annelids.
W. R. COE. The Nemerteans.
REINHARD DOHRN. The Eyes of Deep-Sea Crustacea.
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H. L. CLARK. The Holothurians.
—— The Volcanic Rocks.
—— The Coralliferous Limestones.
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G. W. MÜLLER. The Ostracods.
MARY J. RATHBUN. The Crustacea Decapoda.
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Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding.

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ON THE EXISTENCE OF IMMUNITY PRINCIPLES IN INSECTS.[1]

BY R. W. GLASER.

During the course of my work on various diseases of insects, I have often been confronted by results which seemed to point towards the existence of immunity principles. I failed to become convinced, however, till I instituted a series of experiments meant to prove or disprove my views. Other workers, also, on investigating caterpillar and grasshopper diseases, have been unable to explain some of their results without assuming the possibility of physiological immunity, but direct proof for their contentions has been lacking.

In physiological work of this sort it is very difficult to obtain quantitative data for the reason that the amount of blood obtainable from a particular insect amounts to only one-tenth to one-fifth of a cubic centimeter. In one series of experiments I managed to obtain quantitative results. The other data are qualitative but, I hope, no less important.

THE QUESTION OF PHAGOCYTOSIS.

Since all entomological text-books emphasize the importance of the blood cells in ridding the insect body from the invasion of foreign substances this question was first investigated. In practically all the literature on the subject, insect blood cells are compared with the mammalian white blood corpuscles. An exceedingly aggressive nature is attributed to them and their movements are described as actively amæboid, engulfing foreign substances with great avidity. I was greatly astonished to find that this view was incorrect and that the blood cells are visibly rather passive. Of course, we know that the so-called amæbocytes play an important rôle during metamorphosis, and I do not wish to create the impression that I depreciate the importance of these cells. However, even during metamorphosis their action is not confined to an aggressiveness manifested by movement but rather, I think, to an increase in the secretion of proteolytic and perhaps other enzymes. These break down the larval tissues and prepare the various proteins and other substances for assimilation by the imaginal disks that form the adult tissues.

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[1] Contribution from the U. S. Bureau of Entomology in coöperation with the Bussey Institution of Harvard University. (Bussey Institution, No. 143.)

One gains the impression from text-books that the insect blood cells, called amæbocytes, during metamorphosis, bodily attack those larval tissues destined to destruction; that they swallow masses of such tissues, digest them and then wander over to the imaginal disks where they surrender the digested matter. I will attempt to show that insect blood cells are nor quite as aggressive, as we have been persuaded to suppose, and that one can stimulate the formation of certain substances acting extracellularly. It may be true that these substances are formed by the cells but, on the other hand, it is also possible that they are formed by the blood plasma or serum. After they are formed, however, they act independently of any cellular organization.

During 1916 and 1917 while studying certain bacteria pathogenic to caterpillars, and others pathogenic to grasshoppers, I had occasion to inoculate many insects with different cultures. In some of my experiments several of the insects lived in spite of the fact that enormous numbers of microörganisms, supposedly pathogenic, were introduced. For example: Ten mature female grasshoppers (*Melanoplus femur-rubrum*) were each injected with $^1/_{10}$ c.c. of a 24 hour bouillon culture of *Bacillus poncei* Glaser. *B. poncei* is a highly motile organism which I obtained from the Honduran government in 1915. The bacterium is ordinarily pathogenic to *M. femur-rubrum*. After intervals of ½, 1, 2, and 24 hours the animals were killed and a large metathoracic leg removed from each by breaking the joint between the trochanter and femur. The blood that oozed from each animal was caught on a separate sterile cover-slip. Some of these preparations were fixed by passing through a Bunsen flame, others were immersed in 70 per cent. alcohol, while still others were fixed with Schaudin's corrosive sublimate solution. After fixation, the preparations were dried and stained with methylene blue. Excessive staining can be remedied, of course, by treatment with alcohol. After mounting the preparations were studied and I was astonished to find that they were surprisingly free from *Bacillus poncei*. Six of the smears showed no microörganisms whatever, the remaining ones showed a few bacilli scattered about here and there outside of the blood cells. On examining each smear carefully by studying ten fields with the oil immersion lens, I found only one blood corpuscle with *B. poncei* embedded in its cytoplasm. If the grasshoppers had been permitted to live, I feel sure that only the four revealing any bacteria in the blood would have finally died of the disease. The remaining six would have lived till they succumbed to natural causes. Two animals were examined after $\frac{1}{2}$ hour; two after 1 hour; two after 2 hours and four after 24 hours. The bacteria were found in one case examined after $\frac{1}{2}$ hour, in two examined after 2 hours and in one examined after 24 hours. This experiment was repeated with similar results.

In many of the inoculation experiments with *B. poncei* from one-fourth to one-half of the animals did not die and I then assumed that the blood acted antagonistically towards the introduced bacteria. The blood tests cited above seemed to be evidence in favor of this view. The blood of a certain number of the inoculated animals managed to rid itself of *B. poncei* and, moreover, this riddance was not accomplished by hungry amæbocytes as the text-books would have us believe. If the grasshopper blood cells had phagocytised large numbers of the bacteria I surely would have noticed this in the stained smears. In some cases the blood, however, acted antagonistically towards the bacteria and I will later show more clearly that the antagonistic substances are extracellular and therefore in the blood plasma or serum.

I thought that the tissue culture method might offer some interesting possibilities in studying, *in vitro*, the behavior of insect blood cells towards bacteria. The method for preparing such cultures is very simple and does not differ materially from the well known methods used by Harrison, Carrel, etc. for the cultivation of embryonic mammalian tissue. I shall not describe a method familiar to all biologists.[1]

The results of the following four experiments may be considered characteristic for a large series performed with both grasshopper and army worm blood. The blood of *Melanoplus atlanis* was used for these four experiments and *Coccobacillus acridiorum* d'Herelle, pathogenic to grasshoppers, was the organism used for the artificial contamination of two of the four tissue culture slides. Two slides were considered as checks. They were prepared by mixing a drop ($^1/_{10}$ of a c.c.) of the grasshopper blood with a drop of sterile, neutral, nutrient bouillon. The first day all of the blood cells appeared perfectly normal. On the third day some showed signs of disintegration, whereas others remained normal. On the sixth day the cells destined to disintegrate were completely disorganized. The others remained normal and showed cell division with the formation of syncytial, tissue-like masses. After two weeks the cells still appeared normal and the syncytia had increased considerably in size. The observations were not continued after two weeks. Throughout the entire period the slides had remained perfectly sterile showing that all technical precautions, observed during their preparation, had been adequate. At no time, not even during the first day before the formation of fibrin, did I observe any independent movement on the part of the blood cells. They remained passive and the only visible independent activity observed consisted in cell division on and after the sixth day.

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[1] Those interested in the cultivation of insect blood cells may be referred to R. W. Glaser: "The Growth of Insect Blood Cells in Vitro." PSYCHE, Vol. XXIV, No. 1, 1917.

The two experimental slides were prepared by mixing a drop of the grasshopper blood with a platinum loop-full of a 24 hour culture of the *Coccobacillus acridiorum* d'Herelle, a highly motile organism. The slides were examined as soon as prepared. The blood cells appeared to be perfectly normal and remained entirely passive. The preparations were swarming with the motile bacteria and in ten to twenty minutes many of the bacteria made their way into the cytoplasm of the blood cells. The latter did not engulf the bacteria which seemed to bore their way into the cytoplasm.[1] On the third day the bacteria were no longer motile. They seemed to be multiplying, but appeared in bunches simulating agglutination masses. Some of the blood cells had disintegrated; others appeared perfectly normal and bacteria were no longer visible within the cytoplasm. On the sixth day the bacteria seemed to be in about the same condition; multiplying, bunched and motionless. The blood cells showed cell division and the formation of the tissue-like, syncytial masses. Bacteria were not found within the cytoplasm of any of the cells. In two weeks the two culture slides presented much the same condition with the exception of the blood cell syncytia which were much larger. The observations were discontinued after two weeks.

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[1] This may have been due to surface tension. It may be called phagocytosis if the word is used in a broad sense.

The foregoing experiments were repeated with army worm and gipsy moth caterpillar blood. The results were in perfect harmony with the grasshopper blood observations.

From the tissue culture work, we are forced to conclude that in a mixture of insect blood cells and bacteria, the blood cells are not the visible aggressors. However, the blood seems to be able to overcome bacterial invasion to a certain extent. Substances are elaborated which antagonize the bacteria. On the culture slides, the quantity of the blood is not sufficient, and metabolism is lowered, so that antagonistic substances are not formed so rapidly nor so abundantly as is the case within the body of the insect. For this reason, although the bacteria were rendered ineffective on the culture slides and permitted the blood cells to grow, they were not killed. All of these questions will be more clearly elaborated in the next section.

Extracellular Antagonistic Substances.

In a large series of experiments with grasshoppers (*Melanoplus femur-rubrum*) and *Bacillus poncei* four animals remained alive after two weeks. These animals, like the remainder, which died, had been injected with $^1/_{10}$ of a cubic centimeter of a 24 hour bouillon culture of *B. poncei.* I suspected that these four animals were immune and thought it might be possible to demonstrate the existence of some immunity principle, such as an agglutinin. Of course, on account of the small amount of blood obtainable from a grasshopper, it is extremely difficult to perform a Widal test with all the high dilutions, but I am confident that my experiments are significant in spite of this shortcoming.

Four depression slides were prepared from the four supposedly immune animals. A leg from each grasshopper was broken and a drop of blood from each was caught on a separate sterile cover-slip. To each cover-slip I added one platinum loop-full of a 24 hour bouillon culture of *B. poncei.* The culture was first examined microscopically and the organisms were found to be highly motile. The cover-slips were kept under observation and at first the bacteria swarmed about everywhere at an exceedingly lively rate. The motility seemed to diminish in a few minutes and in 20 minutes to $\frac{1}{2}$ hour the bacteria had agglutinated in large masses and seemed to be dead to all appearances. The four tests were identical and I never saw a better reaction with *Bacillus typhosus* and typhoid serum.

Four depression check slides accompanied the four used in the experiment. These were prepared by adding *B. poncei* to normal *Melanoplus femur-rubrum* blood. The bacteria remained motile till the next day.

The eight slides were prepared under sterile conditions and the edges of the coverslips sealed with sterile vasalene, so that I was able to keep them for six days. At the end of that time when I examined the preparations the agglutination masses presented the same appearance in all four experimental slides. The blood corpuscles, however, had divided and formed syncytia. I inoculated culture tubes from these four slides, but obtained no growth, proving that all the bacteria had been killed. The four check slides proved to be interesting in a different way. On them the bacteria were not motile, but long chains were visible showing life. In some places the bacteria were bunched, but no true agglutination masses were found. On check slide 4 the blood showed signs of growth through the formation of syncytia. The blood corpuscles seemed not to have grown on the other three preparations. Culture tubes were inoculated from these check slides and pure cultures of *B. poncei* were obtained from all.

I thought it would be interesting to obtain some quantitative data in regard to the bactericidal action of immune insect blood. Sixteen *M. femur-rubrum* grasshoppers were injected each with $^1/_{10}$ c.c. of a 24 hour bouillon culture of *B. poncei.* In ten days all but three had died, and since no deaths were recorded for four days I assumed that the three living animals had acquired immunity against the bacteria. Small samples of blood removed from each showed no bacteria microscopically. Under sterile conditions the following experiments were performed in small test tubes. Adequate checks accompanied the series.

Experiments.

(1) 2 drops[1] ♀ *femur-rubrum* immune blood + 1 c.c. bouillon + 1 loop of *B. poncei.*
(2) 2 drops ♀ *femur-rubrum* immune blood + 1 c.c. bouillon + 1 loop of *B. poncei.*
(3) 2 drops ♂ *femur-rubrum* immune blood + 1 c.c. bouillon + 1 loop of *B. poncei.*

Checks.

(1) 2 drops bouillon + 1 c.c. bouillon + 1 loop of *B. poncei.*
(2) 2 drops ♀ *femur-rubrum* normal blood + 1 c.c. bouillon + 1 loop of *B. poncei.*
(3) 2 drops ♂ *femur-rubrum* normal blood + 1 c.c. bouillon + 1 loop of *B. poncei.*

The six test tubes were incubated for 24 hours at 35° C. At the end of that period neutral potato agar plates were poured from the six cultures using the customary one, two, and three dilution method. Each experiment and each check was represented by three plates making eighteen plates altogether. They were incubated for three days at 35° C. after which a count was made of the developed colonies. The colonies on the six first dilution plates (experiments and checks) were too numerous and confluent for counting. Those on the six second dilution plates were also extremely numerous. At a glance one could tell that the colonies on the check plates were more numerous than on the experimental plates. By taking counts of sections of all the plates I arrived at the conclusion that the ratio of check to experimental colonies was about 10: 1.

With the six third dilution plates I was able to make actual colony counts for the three experiments and three checks.

NUMBER OF COLONIES ON THIRD DILUTION PLATES.

	Checks.	*Experiments.*
(1)	7	0
(2)	4	0
(3)	6	0

As can be seen from the foregoing table Checks 1, 2, and 3 gave 7, 4, and 6 colonies respectively, whereas nothing at all was obtained on the three third dilution experimental plates.

These experiments taken in conjunction with the other results I have presented show that it is possible to bring about the formation of bacteriacidal properties in some insects. From my tissue culture work discussed under phagocytosis, I have shown that normal insect blood is somewhat antagonistic towards bacteria, but this antagonism is much more evident in animals that do not die after a bacterial infection, i.e., animals which are immune.

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[1] Two drops equals $^1/_6$ of a cubic centimeter. This is the maximum amount of blood which one can obtain from one animal at a time.

If it were only possible to inject an insect more than once without producing fatal results, I am sure one could obtain still more interesting results. I have often made two trials but grasshoppers and caterpillars, at least, do not seem able to overcome the effects of a second injection.

SUMMARY.

1. Entomological text-books emphasize the importance of phagocytosis in ridding the insect body of foreign matter, but in reality insect blood cells are visibly rather passive.
2. Grasshopper and caterpillar blood cells do not seem to phagocytise bacteria in an amæboid fashion.
3. When bacteria are found within the blood cells, they may have gained entrance through their own aggression or physical factors may have been involved.
4. The blood of normal insects, however, is somewhat antagonistic towards bacteria.
5. This antagonism acts extracellularly.
6. Actively immunized grasshopper blood shows a high degree of antagonism towards the bacteria used in producing this immunity.
7. An agglutinin was found in immune grasshopper blood.
8. Some quantitative data on the bacteriacidal action of immune grasshopper blood were obtained.

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THE PHORIDAE OF GRENADA.

By Charles T. Brues.

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Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905, Lieutenant Commander L. M. Garrett, U. S. N., Commanding, published or in preparation: —

A. AGASSIZ. V.[5] General Report on the Expedition.
A. AGASSIZ. I.[1] Three Letters to Geo. M. Bowers, U. S. Fish Com.
H. B. BIGELOW. XVI.[16] The Medusae.
H. B. BIGELOW. XXIII.[23] The Siphonophores.
H. B. BIGELOW. XXVI.[26] The Ctenophores.
R. P. BIGELOW. The Stomatopods.
O. CARLGREN. The Actinaria.
R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
H. L. CLARK. The Starfishes.
H. L. CLARK. XXX.[30] The Ophiurans.
S. F. CLARKE. VIII.[8] The Hydroids.
W. R. COE. The Nemerteans.
L. J. COLE. XIX.[19] The Pycnogonida.
W. H. DALL. XIV.[14] The Mollusks.
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S. GARMAN. XII.[12] The Reptiles.
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P. KRUMBACH. The Sagittae.
R. VON LENDENFELD. XXI.[21] The Siliceous Sponges.
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W. E. RITTER. IV.[4] The Tunicates.
B. L. ROBINSON. The Plants.
G. O. SARS. The Copepods.
F. E. SCHULZE. XI.[11] The Xenophyophoras.
HARRIET R. SEARLE. XXVIII.[28] Isopods.
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E. C. STARKS. XIII.[13] Atelaxia.
TH. STUDER. The Alcyonaria.
JH. THIELE. XV.[15] Bathysciadium.
T. W. VAUGHAN. VI.[6] The Corals.
R. WOLTERECK. XVIII.[13] The Amphipods.

[1] Bull. M. C. Z., Vol. XLVI., No. 4, April, 1905, 22 pp.
[2] Bull. M. C. Z., Vol. XLVI., No. 6, July, 1905, 4 pp., 1 pl.
[3] Bull. M. C. Z., Vol. XLVI., No. 9, September, 1905, 5 pp., 1 pl.
[4] Bull. M. C. Z., Vol. XLVI., No. 13, January, 1906, 22 pp., 3 pls.
[5] Mem. M. C. Z., Vol. XXXIII., January, 1906, 90 pp., 96 pls.
[6] Bull. M. C. Z., Vol. L., No. 3, August, 1906, 14 pp., 10 pls.
[7] Bull. M. C. Z., Vol. L., No. 4, November, 1906, 26 pp., 4 pls.
[8] Mem. M. C. Z., Vol. XXXV., No. 1, February, 1907, 20 pp., 15 pls.
[9] Bull. M. C. Z., Vol. L., No. 6, February, 1907, 48 pp., 18 pls.
[10] Mem. M. C. Z., Vol. XXXV, No. 2, August, 1907, 56 pp., 9 pls.
[11] Bull. M. C. Z., Vol. LI., No. 6, November, 1907, 22 pp., 1 pl.
[12] Bull. M. C. Z., Vol. LII., No. 1, June, 1908, 14 pp., 1 pl.
[13] Bull. M. C. Z., Vol. LII., No. 2, July, 1908, 8 pp., 5 pls.
[14] Bull. M. C. Z., Vol. XLIII., No. 6, October, 1908, 285 pp., 22 pls.
[15] Bull. M. C. Z., Vol. LII., No. 5, October, 1908, 11 pp., 2 pls.
[16] Mem. M. C. Z., Vol. XXXVII., February, 1909, 243 pp., 48 pls.
[17] Mem. M. C. Z., Vol. XXXVIII., No. 1, June, 1909, 172 pp., 5 pls., 3 maps.
[18] Bull. M. C. Z., Vol. LII., No. 9, June, 1909, 26 pp., 8 pls.
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[20] Bull. M. C. Z., Vol. LII., No. 13, September, 1909, 48 pp., 4 pls.
[21] Mem. M. C. Z., Vol. XLI., August, September, 1910, 323 pp., 56 pls.
[22] Bull. M. C. Z., Vol. LIV., No. 7, August, 1911, 38 pp.
[23] Mem. M. C. Z., Vol. XXXVIII., No. 2, December, 1911, 232 pp., 32 pls.
[24] Bull. M. C. Z., Vol. LIV., No. 10, February, 1912, 16 pp., 2 pls.
[25] Mem. M. C. Z., Vol. XXXV., No. 3, April, 1912, 98 pp., 8 pls.
[26] Bull. M. C. Z., Vol. LIV., No. 12, April, 1912, 38 pp., 2 pls.
[27] Mem. M. C. Z., Vol. XXXV., No. 4, July, 1912, 124 pp., 12 pls.
[28] Bull. M. C. Z., Vol. LVIII., No. 8, August, 1914, 14 pp.
[29] Mem. M. C. Z., Vol. XLII., June, 1915, 397 pp., 109 pls.
[30] Bull. M. C. Z., Vol. LXI., October, 1917, 28 pp., 5 pls.

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THE PHORIDAE OF GRENADA.

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No. 12.— *The Phoridae of Grenada.*

By Charles T. Brues.

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION, HARVARD UNIVERSITY, No. 144.

The small island of Grenada lies at the southern end of the windward group in the West Indies. In spite of its proximity to Trinidad which supports a continental fauna, the insect inhabitants seem rather limited in number of species. When I visited this island in 1910 for another purpose in behalf of the Museum of Comparative Zoölogy, I had the opportunity to collect a number of insects some of which belong to the Phoridae. I was particularly interested in these small flies at the time, and brought back specimens representing nine species. Mr. H. H. Smith collected many insects in Grenada some twenty years before and obtained several species two of which I failed to find in 1910.

The following list includes the known species from the island including three which are new to science.

Paraspiniphora scutellata Brues.

The type of this species which is a female is from Grenada. I collected a male in 1910, which differs in having the anterior scutellar bristle much smaller than the posterior one. This is probably a sexual character.

Dohrniphora venusta Coquilett.

This is common in Grenada as in most parts of the American tropics. From specimens collected in Grenada and St. Vincent by H. H. Smith it was redescribed as *divaricata* by Aldrich. It was also obtained in Grenada by Busck and myself.

Dohrniphora alleni, sp. nov.

Type.— M. C. Z. 7,005. Grenada, C. T. Brues.

♂. Length 3.5 mm. Black; pleurae and base of middle coxae piceous, antennae fuscous, palpi reddish brown; legs dull brownish yellow; hypopygial projection yellow; wings tinged with brown, venation piceous. Front as broad as high; carinate above the median pair of ocellar bristles, the carina curving down laterally below the lateral ocellar bristles; postantennal pair of bristles close together, not far below the level of the next row which form a nearly equidistant series curved downwards medially; upper row slightly curved upwards medially; ocelli not on a tubercle; all frontal bristles large. Postocular cilia enlarged at upper two thirds of eye. Cheeks each with two macrochaetae. Antennae small, nearly round; arista nearly twice as long as the front. Palpi not enlarged, with stout bristles below on apical third. Mesonotum shining, pubescent, slightly bristly along the sides; one pair of dorsocentral bristles. Scutellum short and broad; posterior pair of bristles far apart and very long, anterior pair much smaller. Propleurae hairy, with two bristles near the coxa and one large one midway between the coxa and spiracle; also a bristle above the spiracle; mesopleura not hairy. Abdomen with second and sixth segments elongated; third, fourth, and fifth subequal in length; surface dull except at apex, without hairs except a few on the sixth segment which also bears some bristles on posterior edge; hypopygium rather small; projecting piece slender, bearing only a few very small hairs towards apex. Legs stout; front tibia with a small bristle just beyond basal third, but no others; middle tibiae with a pair at basal third and a small one on anterior surface just before apex; anterior surface on apical third with transverse comb-like rows of very short bristles; hind tibiae with a shorter patch of similar comb-like rows at apex, without bristles or setulae before apex although the hairs are larger on the seam and just outside it on the apical half of the tibia; hind femur without a patch of short bristles on inner side at base. Wings long and narrow; two and one half times as long as broad; costa extending to the middle or barely beyond; first section of the costa twice as long as second and third together, third nearly as long as second; fork rather acute; fourth vein feebly curved, recurved at apex; fifth nearly straight; sixth sinuate; seventh strongly curved basally; costal cilia rather short, about as long as the humeral cross-vein. Halteres light fuscous.

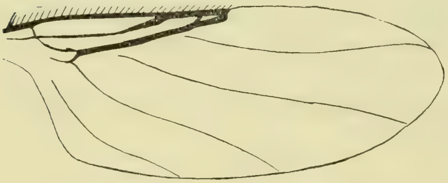

Fig. 1.— Dohrniphora alleni Brues. Wing.

Named for Dr. G. M. Allen, my companion in Grenada on the trip when the specimen was collected.

Since this was written I have seen additional specimens from Falls Church, Va., collected by Mr. Nathan Banks.

This species resembles *D. incisuralis* and *D. venusta* in the presence of pale color on the body, but is more closely similar structurally to *D. concinna* and its relatives except in the bare hind tibiae. It is related to *D. setigera* Malloch, but is without setulae on the hind tibiae, has shorter costal cilia and paler halteres.

The species of Dohrniphora known from North and Central America may be distinguished by the following key:—

1. Front tibiae with a serial row of four or five small, erect setae of subequal size; no bristle on prothorax just above spiracle. . 2.

Front tibiae with one bristle at basal third and without additional setulae, prothorax with a bristle just above the spiracle; mesopleura entirely bare . . . . 5.

2. Head tibiae without any setulae . . . . 3.

Hind tibiae with four or five serially arranged setulae on outer side . . . . *D. incisuralis* Loew.

3. Black; legs brown, front pair varied with yellowish. *D. knabi* Malloch.

Thorax yellow, at most with the dorsum darker, hind femora of male with a small patch of bristles on inner side near base . 4.

4. Antennae not enlarged, of normal size . . . *D. venusta* Coquilett.

Antennae enlarged in both sexes; those of male pyriform. *D. dispar* Enderlein.

5. Hind tibiae with some minute setulae on inner, outer, or on both sides; palpi and legs usually black . . . . 6.

Hind tibiae without setulae before apex; palpi and legs yellowish brown . . . . *D. alleni* Brues.

6. Hind tibiae with setulae only on outer side; male antennae not noticeably enlarged . . . . 7.

Hind tibiae with a series of setulae on inner side as well as on outer; male antennae much enlarged . . . . *crassicornis* Meigen.

Hind tibiae with a series of short setulae inside the seam; legs pale . . . . *D. setigera* Malloch.

7. Front quadrate; postantennal bristles below the next row by more than half the distance separating this row from the upper row; halteres black; sixth segment of male strongly bristly. *D. cimbicis* Aldrich.

Front distinctly wider than long; postantennal bristles below the next row by less than half the distance separating this row from the upper row; halteres pale; sixth segment of male faintly bristly (*nitidifrons* Brues)........*D. concinna* Meigen.

HYPOCERA GRENADENSIS Brues.

The type is from Grenada, collected by H. H. Smith.

CONICERA NEOTROPICA Brues.

Originally described from a specimen taken in Grenada by H. H. Smith.

BECKERINA NEOTROPICA, sp. nov.

Type.— M. C. Z. 7,006. *Paratype.*— Grenada; Grand Etang, 2,500 ft.

♀. Length 2.6 mm. Pale brownish yellow; front black except near lower margin; abdomen infuscated at base and with blackish apical bands on the segments; legs pale yellowish, hind femora blackened at tip; wings slightly tinged with yellow; halteres with pale stalk and fuscous club; antennae fuscous; palpi pale yellow. Front with ocellar tubercle and well-marked median groove; almost as high as wide, but appearing shorter as the lower edge is more strongly produced medially than usual. Two postantennal bristles which are slightly curved upwards although nearly erect; next row complete, of four bristles, forming a line curved down medially, with the median pair farther from one another than from the lateral one, all close to the lower margin; next row similarly curved, of four nearly equidistant bristles; ocellar row of large bristles as are the others; in addition to the large bristles there are scattered small ones especially noticeable along the lower edge, with two somewhat larger just above the pair of postantennals. Postocular cilia large, cheeks each with three macrochaetae. Antennae small, round, arista nearly twice as long as the front. Palpi small, strongly bristled on apical half, weakly so nearer the base. Mesonotum with six rather small bristles in a nearly straight line near posterior margin. Scutellum short, transverse, with four large, equally strong bristles on the margin, the median pair approximated, much less than twice as far from one another as from the adjacent lateral one. Propleura bristly behind, with two large bristles next the coxa and four less enlarged above near the spiracle; a bristle directly above spiracle. Mesopleura entirely bare. Abdomen with a tuft of bristles at sides of second segment and a row of minute ones along the posterior margin of each segment. Legs large, but not especially stout, all tibiae without bristles or setulae before apex; hind tibiae but not middle ones with a small patch of transverse comb-like rows of bristles inside at apex; tarsi slender. Wings small, broad basally, but much narrowed beyond middle; costa extending to slightly beyond middle of wing, the third vein widely separated from the costa; costal cilia rather short, closely placed; first section of costa scarcely longer than the second and third together, second twice as long as third, fork not very acute, the cell thus formed rather large, fourth vein evenly bent, not recurved at tip; fifth vein nearly straight; sixth faintly bisinuate; seventh nearly straight.

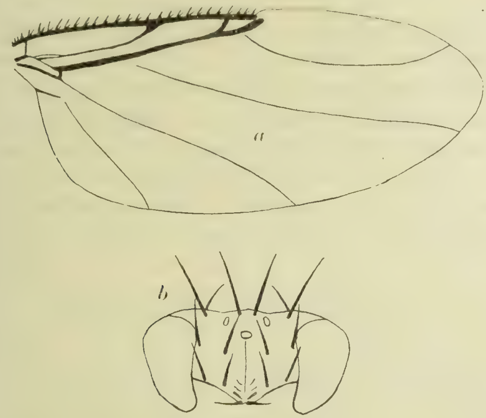

Fig. 2.— Beckerina neotropica Brues. a, wing: b, front showing chaetotaxy.

This peculiar species is probably referable to Beckerina although the bristling of the front is complete, with four bristles in the lower row, not two as occur in *B. orphnephiloides* Malloch. I have not seen the other member of the genus, *B. umbrimargo* Becker of Europe, but as nearly as I can gather from Becker's description the frontal chaetotaxy of that species is similar to the present one from Grenada. The tibiae are without bristles as in Aphiochaeta and do not even show the small setulae usually present on the hind pair in that genus.

APHIOCHAETA CARIBBAEA, sp. nov.

Type.— M. C. Z. 7,007. Grenada, H. H. Smith.

♀. Length 2.2 mm. Dull yellow, with the front and antennae black, and the abdomen much infuscated, especially at the base and apex, but with the apical margins of all the segments pale; legs pale yellowish, the posterior femora darkened at tips; wings with a yellowish cast, veins light brown, the light veins strongly colored; halteres pale brown. Front quadrate, with strong bristles; four proclinate bristles, the lower pair nearly as large as the upper and half as far apart; upper pair occupying nearly one third of the width of the front, far above the lower pair and a little above the inner bristles of the lower reclinate row; outer bristle of the lower reclinate row next to the eye and well above the inner bristle which is far from the eye; upper reclinate row of four equidistant bristles with the median pair slightly lower than the lateral bristles; ocellar tubercle prominent; median frontal groove rather indistinct; cheeks each with a pair of bristles and several small ones running up the inner orbit toward the antennae. Antennae rather small; arista strongly pubescent, scarcely twice as long as the height of the front; palpi large, compressed, with several large bristles below on apical third and some much smaller ones before these. Mesonotum somewhat shining, the dorsocentral machrochaetae present, with not much larger than a row of smaller bristles that extends between them. Scutellum subtriangular, with four large, equal bristles. Propleura with several rather slender bristles next the front coxa and some smaller ones above, several scattered over the disc and several next the spiracle; mesopleura with a patch of fine hair-like bristles above and one much larger one at the posterior edge of the group of small ones. Although much larger than the others, this bristle is not so large as in some other species like *A. juli*. Abdomen with distinct bristles at the sides of the second segment. Legs rather stout; fore tarsi slender; hind tibiae with very small cilia on the basal half, those on the apical half moderately well developed although delicate and placed far apart. Wings long and narrow, the costa extending well beyond the middle, costal cilia quite short, especially at the base; first section of costa, barely shorter than the second and third combined; second three times as long as the third; fork of third vein moderately acute; fourth vein gently curved at both base and apex; fifth almost straight; sixth slightly bisinuate; seventh long, nearly straight.

This is related to *A. arcuata* Malloch from the eastern United States, but is easily separable by the chaetotaxy of the front and by the fact that only one mesopleural bristle is large. In the latter respect it resembles *A. juli* Brues and *A. perdita* Malloch from both of which it is otherwise very different.

APHIOCHAETA MAGNIPALPIS Aldrich.

This species was described from specimens taken by H. H. Smith in St. Vincent and Grenada. I collected it again in Grenada. It is a peculiar little species with the mesopleura bare above and the front tarsi noticeably enlarged, especially in the male. It may be easily recognized by the bare, greatly enlarged palpi of the male and by the almost parallel course of the fifth and sixth veins in the wing.

APHIOCHAETA AUREA Aldrich.

Originally described by Aldrich from specimens obtained by H. H. Smith in St. Vincent, but also collected by him in Grenada. It appears to be a common species in Grenada as I took numerous specimens of each sex in the high central part of the island.

APHIOCHAETA AUREA SETIGERA, subsp. nov.

Type.— M. C. Z. 7,008. Grenada, H. H. Smith.

♀. Length 2 mm. Very similar to the typical *A. aurea* Aldrich, but with a distinct patch of very small bristles at the upper angle of the mesopleura; these are not numerous, but always present. It also differs in having the wings without the deep yellow cast and the abdomen without the brilliant orange color usually so noticeable near the center of the abdomen in the typical form.

Type and three paratypes from Grenada, B. W. I. (H. H. Smith). Two were taken at 500 ft. altitude and the altitude is not indicated on the other labels.

This is so similar to *A. aurea* that it can hardly be considered as a distinct species in spite of the bristly mesopleura which is ordinarily a most satisfactory character. I suspect that it is characteristic of the lower and drier hills while *A. aurea* is restricted to the higher, moist mountain region as the specimens of the latter which I have labeled as to altitude came from stations at 1,000, 1,500, and 2,500 feet.

APHIOCHAETA SCALARIS Loew.

A common, widespread species in the warmer parts of America. Taken in Grenada by both Smith and myself. The specimens in both lots are rather small but otherwise typical.

APHIOCHAETA SUBFLAVA Malloch.

Of this species described from Porto Rico, I took a number of specimens in Grenada. It is very close to *A. scalaris* and quite possibly not entitled to specific rank.

PULICIPHORA VENATA Aldrich.

The male of this species was described from a specimen collected by H. H. Smith in St. Vincent. I found both sexes to be very abundant at the Grand Etang in Grenada at an altitude of 2,500 feet. The males were to be seen running on the inside of the glazed windows of the house and the females were attracted in numbers to traps placed out of doors. The traps consisted of glass jars sunk into the ground in the forest and baited with chicken bones. On visiting the jars, the Puliciphoras were found running over the surface of the glass and bait to which they were undoubtedly attracted by the carrion-like odor. Whether they oviposited in the material could not be determined and there was no opportunity to attempt rearing them at the time.

I have not undertaken to describe the female as it is very similar to those of several other species and the genus needs critical study. It differs from *P. borinquenensis* Wheeler from Porto Rico in its broader and shorter thorax and in the more complete chaetotaxy of the head. From the Mexican *P. incerta* Silvestri of which I have seen no specimens, it appears to differ in the same characters, as well as in the form of the abdominal tergites.

The following Publications of the Museum of Comparative Zoölogy are in preparation:—

LOUIS CABOT. Immature State of the Odonata, Part IV.
E. L. MARK. Studies on Lepidosteus, continued.
E. L. MARK. On Arachnactis.

Reports on the Results of Dredging Operations in 1877, 1878, 1879, and 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," as follows:—

A. MILNE EDWARDS and E. L. BOUVIER. The Crustacea of the "Blake."
A. E. VERRILL. The Alcyonaria of the "Blake."

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieutenant Commander Z. L. Tanner, U. S. N., commanding, in charge of Alexander Agassiz, as follows:—

K. BRANDT. The Sagittae.
K. BRANDT. The Thalassicolae.
O. CARLGREN. The Actinarians.
R. V. CHAMBERLIN. The Annelids.
W. R. COE. The Nemerteans.
REINHARD DOHRN. The Eyes of Deep-Sea Crustacea.
H. J. HANSEN. The Cirripeds.
H. J. HANSEN. The Schizopods.
W. A. HERDMAN. The Ascidians.
S. J. HICKSON. The Antipathids.
E. L. MARK. Branchiocerianthus.
JOHN MURRAY. The Bottom Specimens.
P. SCHIEMENZ. The Pteropods and Heteropods.
THEO. STUDER. The Alcyonarians.
H. B. WARD. The Sipunculids.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., commanding, as follows: —

R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
——— The Volcanic Rocks.
——— The Coralliferous Limestones.
S. HENSHAW. The Insects.
G. W. MÜLLER. The Ostracods.
MARY J. RATHBUN. The Crustacea Decapoda.
G. O. SARS. The Copepods.
L. STEJNEGER. The Reptiles.
T. W. VAUGHAN. The Corals, Recent and Fossil.
A. WETMORE. The Mammals and Birds.

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE.

There have been published of the BULLETIN Vols. I. to LIV., LVI., and Vols. LVIII. to LXI.; of the MEMOIRS, Vols. I. to XXXVIII., and also Vols. XL. to XLII., XLIV. to XLVI.

Vols. LV., LVII., LXII. and LXIII. of the BULLETIN, and Vols. XXXIX., XLIII., XLVII. to XLIX. of the MEMOIRS, are now in course of publication.

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The following publications are in preparation:—

Reports on the Results of Dredging Operations from 1877 to 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," Lieut. Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., commanding.

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieut. Commander Z. L. Tanner, U. S. N., commanding, in charge of Alexander Agassiz.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., commanding.

Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from October, 1904, to April, 1905, Lieut. Commander L. M. Garrett, U. S. N., commanding.

Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

Contributions from the Geological Laboratory, Professor R. A. Daly, in charge.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Mass.

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AT HARVARD COLLEGE.

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By William Morton Wheeler.

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Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905, Lieutenant Commander L. M. Garrett, U. S. N., Commanding, published or in preparation: —

A. AGASSIZ. V.[5] General Report on the Expedition.
A. AGASSIZ. I.[1] Three Letters to Geo. M. Bowers, U. S. Fish Com.
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[1] Bull. M. C. Z., Vol. XLVI., No. 4, April, 1905, 22 pp.
[2] Bull. M. C. Z., Vol. XLVI,. No. 6, July, 1905, 4 pp., 1 pl.
[3] Bull. M. C. Z., Vol. XLVI., No. 9, September, 1905, 5 pp., 1 pl.
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No. 3.— *The Ants of Borneo.*

By William Morton Wheeler.

CONTRIBUTIONS FROM THE ENTOMOLOGICAL LABORATORY OF THE BUSSEY INSTITUTION OF HARVARD UNIVERSITY, NO. 145.

During the past decade several collections of Bornean ants have been sent me for study and identification. Mr. John Hewitt sent an interesting lot of specimens accumulated during his residence in Kuching and Prof. Harrison W. Smith, of the Massachusetts Institute of Technology, made a collection in the same locality for the Museum of Comparative Zoölogy. He also contributed a number of specimens collected in British North Borneo by Mr. E. B. Kershaw, a clever young naturalist who lost his life in that country in a forest fire. Prof. Roland Thaxter of Harvard University gave me a number of small species from Sarawak, and Mr. Horace Donisthorpe kindly sent several that had been taken by Mr. G. E. Bryant on Mt. Matang, near Kuching. Recently a few additional specimens were received from Mr. William Beebe, of the New York Zoölogical Park.

While working up this material I found it necessary to prepare a complete list of the known Bornean Formicidae with their more important synonymy and distribution. During recent years less attention has been bestowed on the ants of Borneo than on those of Java, Sumatra, the Malay Peninsula, Burmah, and India. The Bornean fauna has, however, considerable historical interest to the taxonomist, because it has been studied by all the leading myrmecologists, Smith, Mayr, Ernest André, Emery, and Forel, and because the researches of several of these investigators were based on material secured by such well-known collectors and explorers as Alfred Russel Wallace, Doria, Beccari, Bedot, Pictet, and Chaper. Thus Borneo has come to be the type-locality for many interesting species later found to have a wide distribution in Indonesia. The material sent me by Hewitt and Harrison W. Smith is valuable because it was taken in the very localities in which Wallace collected. Professor Smith has given me the following notes in regard to some of these:

"*Serambu* is the little mountain a few miles up country from Kuching, on the Sarawak River, where the first Rajah had his bungalow and where Wallace made the celebrated collection of moths to which he refers in "The Malayan Archipelago."

"*Rambungan River* is a small stream entering the sea about ten miles south of the Sarawak River. The specimens were taken about twelve miles from the coast.

"*Sadong* is the town on the Sadong River where the first coal mine was started.

"*Matang Mountain* is the beautiful mountain which one sees from Kuching."

The total number of species of which I have been able to make a record from Borneo is 256. I may have overlooked a few, owing to the widely scattered publication of the original descriptions and citations of localities. On the whole, the fauna has many forms in common with Sumatra, Java, and the Malay Peninsula, and additional exploration will no doubt greatly increase the number of such species. Quite a number of forms, however, seem to be peculiarly Bornean. The total number of genera is 59, distributed among the five subfamilies as follows: Ponerinae 18, Dorylinae 2, Myrmicinae 23, Dolichoderinae 4, Camponotinae 12. The following pages add some 58 species (indicated by an asterisk) to the known fauna, including 23 new to science.

The series of Bornean ant genera comprises several of ancient aspect, *e.g.*, Cerapachys, Phyracaces, Metapone, Acanthomyrmex, Calyptomyrmex, Rhopalothrix, Cataulacus, Myrmoteras, Aphomomyrmex, Oecophylla, Gesomyrmex, Dimorphomyrmex, and Echinopla. Some of these seem to be confined to the mountains of Borneo and to be represented also in the mountains of Burmah and the Philippines. One species, *Gesomyrmex chaperi*, is unusually interesting, as it is peculiar to Borneo. The genus was first described by Mayr in 1868 from the Baltic Amber, and many years elapsed before the living Bornean species was discovered by Ernest André (1892). In the same paper André described a species of Dimorphomyrmex from Borneo and three years later Emery recorded a fossil species from the Baltic Amber. Recently I described a second living species from the mountains of Luzon. It is probable, therefore, that careful exploration of the mountains of Borneo and the neighboring islands will bring to light other interesting relicts of the once very widely distributed Eocene ant-fauna.

Some of the Bornean ant-genera are very rich in species, *e.g.*, Crematogaster, which is remarkable also in comprising more numerous forms with 10-jointed antennae (subgen. Decacrema) and swollen epinotum (subgen. Physocrema) than occur in other regions. Leptogenys is represented by several large and handsome species of the subgenus Lobopelta, and Cataulacus, Dolichoderus (subgen. Hypoclinea), Polyrhachis, and Echinopla are also rich in species. All but three of the subgenera of Polyrhachis (Hagiomyrma, Hedomyrma, and Myrmatopa) are known to occur in the island. Of Camponotus the subgenera Myrmotarsus and Colobopsis are represented by numerous species, while most of the other subgenera are rather poorly represented, though often by peculiar forms (Myrmoturba, Myrmosphincta). Compared with the Philippines and the adjacent mainland, and especially with Papua and Australia, Borneo seems to possess few species of Pheidole and Monomorium, and many primitive ponerine genera have not been recorded from the island, *e.g.* Mystrium, Stigmatomma, Trapeziopelta, Prodiscothyrea, Cryptopone, and Centromyrmex. I believe, however, that some or all of these will be found in Borneo. Only recently I received species of Mystrium, Stigmatomma, Trapeziopelta, and Centromyrmex from the Philippines, where they were previously unknown. Of course, Borneo has been invaded by the usual tropicopolitan tramp species, *Monomorium pharaonis* and *floricola, Tetramorium guineense* and *simillimum, Pheidole megacephala, Triglyphothrix striatidens, Plagiolepis longipes,* and *Prenolepis longicornis,* and *obscura.*

FORMICIDAE: PONERINAE.

1. CERAPACHYS ANTENNATUS Smith.

Cerapachys antennatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 74, ☿; Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 445, ♀, pl. 1, fig. 8, 9; Emery, Gen. Ins. Ponerinae, 1911, p. 9, ☿ ♀.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Worker. Length 5.5 mm.

Head distinctly longer than broad, narrower in front than behind, with straight sides, broadly concave occipital border, acute occipital angles and convex dorsal surface, subtruncate behind. Eyes rather large, flattened, their anterior orbits at the middle of the head. There is a small shallow impression on the middle of the vertex. Occipital border marginate, the margination surrounding the corners and continued some distance along the ventral surface of the head. Gula with a pair of small, prominent teeth at its anterior margin. Mandibles rather large, triangular, strongly bent at the base, flattened, with straight lateral and broad, dentate apical borders. Clypeus extremely short and transverse. Frontal carinae prominent, vertical, approximated and rounded, confluent but not truncated behind in a depression continuous with the antennal foveae. In front between the carinae there is a small, acute, median tooth. Frontal groove absent. Cheeks with a strong carina, terminating anteriorly in a sharp, rectangular tooth or projection. Antennae short; scapes rapidly enlarging towards their apices, which reach back to a line connecting the anterior orbits; funiculi thick, all the joints except the last decidedly broader than long, joints 1–6 much broader than long, joints 7–10 subequal, somewhat longer, terminal joint very large, glandiform, as long as the four preceding joints together. Thorax narrower than the head, about 2½ times as long as broad, as broad through the epinotum as through the pronotum, narrowed in the mesoëpinotal region; with indistinct, slightly impressed mesoëpinotal suture. Pronotum subrectangular in front, its anterior and inferior borders strongly marginate. In profile the dorsal outline of the thorax is horizontal and very feebly convex. Epinotum from above a little longer than broad, rather rounded on the sides, its declivity sloping, slightly concave and strongly marginate above and on the sides. Petiole narrower than the epinotum, distinctly longer than broad, as broad in front as behind, with feebly rounded sides and dorsal surface, the former slightly carinate below; its ventral surface anteriorly with a prominent, compressed, triangular tooth. The anterior surface is strongly truncated and with a sharp carina above. Postpetiole a little longer than the petiole but distinctly broader, longer than broad and broader behind than in front, with evenly convex dorsal, ventral, and lateral surfaces, its anterior border strongly marginate, with sharply angular corners. Gaster elongate, first segment shaped like the postpetiole but larger; pygidium truncated and slightly concave above, bordered with numerous prominent spinules. Sting large. Legs with short tibiae, those of the middle and hind legs not longer than the metatarsi; hind coxae without a lamelliform expansion at the tip on the inner side.

Shining; mandibles opaque, striatopunctate; cheeks very coarsely rugose. Surface of the body with very sparse, coarse, piligerous punctures, longitudinally confluent on the dorsolateral surfaces of the petiole.

Hairs moderately long, bristly, erect, pale yellowish, sparse on the body, sparser on the scapes and legs. Pubescence absent, except on the funiculi tibiae, and tarsi.

Black; mandibles, funiculi, tarsi, tips and bases of scapes, femora, and tibiae, pygidium and sting deep red.

A single specimen from Kuching (John Hewitt).

I have redescribed this insect which is the type of the genus, as the worker has not been seen within recent years and because Smith's description is antiquated and incomplete. Emery described and figured a deälated female from Sumatra. Compared with his figures, the worker has the petiole distinctly longer and more narrowed in front, and the head is also narrower anteriorly.

2. CERAPACHYS DOHERTYI Emery.

Cerapachys dohertyi Emery, Rend. R. accad. sci. Bologna, 1901, p. 25, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 9, ☿.

Type-locality: Pulo Laut, Borneo (W. Doherty).

3. CERAPACHYS PARVULUS Emery.

Cerapachys dohertyi var. *parvula* Emery, Rend. R. accad. sci. Bologna, 1901, p. 25, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 9.

Type-locality: Pulo Laut, Borneo (W. Doherty).

As Emery surmised, this is, in all probability, a distinct species and not a variety of *dohertyi*.

*4. CERAPACHYS BRYANTI, sp. nov.

Worker. Length 2 mm.

Head about ¼ longer than broad, a little broader behind than in front, with very feebly convex sides, broadly excised and marginate posterior border and sharp posterior angles. Eyes distinctly smaller than the greatest diameter of the scapes, their posterior orbits at the middle of the head. Cheeks with a prominently angled carina in front. Mandibles small, not flexed at the base, with feebly rounded lateral and very indistinctly denticulate apical borders. Frontal carinae prominent, erect, approximated, rounded, subtruncate, but not fusing behind. Frontal groove absent. Antennal scapes thick, about half as long as the head, joints 1–10 of the funiculus very short and transverse, terminal joint large, glandiform, as long as the six preceding joints together. Thorax narrower than the head, elongate, subrectangular, flattened above and on the sides, twice as long as broad, not broader behind than in front, slightly narrowed in the middle, without promesonotal or mesoëpinotal sutures. Anterior border of pronotum very straight and transverse, its superior and inferior borders as well as the superior and lateral borders of the abrupt epinotal declivity marginate. Petiole nearly square, very slightly broader behind than in front, narrower than the epinotum, truncated and sharply marginate in front, but not on the sides. Postpetiole shaped exactly like the petiole, but larger. Gaster formed very largely of the first segment, which has the same shape as the postpetiole but is somewhat larger. Terminal gastric segments small. Pygidium minutely and rather bluntly spinulate on the sides. Sting well-developed. Legs short and robust, hind coxae without a lamelliform enlargement at the tip on the inner side.

Shining; head, thorax, petiole, and postpetiole evenly covered with sparse, coarse umbilicate, piligerous punctures or foveolae, excepting the middorsal portion of the thorax, which is smooth and very shining. Gaster sparsely punctate, more finely than the more anterior regions, legs and scapes with sparser, finer punctures.

Hairs pale yellow, sparse, erect, bristly, of uneven length, less numerous on the appendages than on the body. Pubescence absent, except on the funiculi.

Castaneous; mandibles, antennae, pygidium, sting, and legs, excluding the coxae, red.

Described from a single specimen sent me by Mr. Horace Donisthorpe. It was taken by Mr. G. E. Bryant on Mt. Matang in West Sarawak.

This species has the appearance of a Syscia on account of its small size and the structure of the thorax and abdomen, but the antennae are 12-jointed as in Cerapachys *sens. str.* It is allied to *C. dohertyi* Emery and *parvula* Emery, but both of these forms are decidedly larger and have the petiole and postpetiole broader than long.

5. PHYRACACES PUBESCENS Emery.

Phyracaces pubescens Emery, Rend. R. accad. sci. Bologna, 1901, p. 26, ♀; Emery, Gen. Ins. Ponerinae, 1911, p. 11, ♀.

Type-locality: Pulo Laut, Borneo (W. Doherty).

*6. PHYRACACES HEWITTI, sp. nov.

Worker. Length 3.5 mm.

Head a little longer than broad, scarcely broader behind than in front, with feebly rounded sides, broadly excavated posterior border and sharp posterior corners, both strongly marginate. In profile the dorsal surface is moderately convex, subtruncate behind, the gular surface feebly convex. Eyes rather large, feebly convex, distinctly in front of the middle of the head. Mandibles triangular, strongly bent at the base, with nearly straight external and indistinctly denticulate apical borders. Frontal carinae approximated, erect, rounded, united but not truncated behind. Cheeks with a short, strong carina, terminating in front in an acute, rectangular tooth. Antennal scapes thickened towards their tips, which extend a little beyond the posterior orbits; funiculi rather long, joints 1–9 broader than long, joint 10 as long as broad, terminal joint as long as the two preceding joints together, somewhat tapering and not broader than the penultimate joint. Thorax slightly narrower than the head, distinctly broader through the epinotum than through the pronotum, less than twice as long as broad, without promesonotal and mesoëpinotal sutures. Pro- and mesonotum together rectangular, as long as broad; epinotum with rounded, rather swollen sides. In profile the whole thorax is feebly and evenly rounded above. Epinotal declivity abrupt, very strongly carinate above and on the sides, as is also the pronotum. Pleurae concave. Petiole as broad as the epinotum, rectangular, nearly 1½ times as broad as long, as broad in front as behind, feebly convex above, truncated anteriorly and posteriorly, with its anterior and lateral borders marginate and its posterior angles produced as a pair of triangular, rather acute teeth. Postpetiole rectangular, a little broader than long, as broad in front as behind and as broad as the petiole, feebly convex above, marginate in front, with sharp anterior corners, submarginate on the sides. First gastric segment a little larger than the postpetiole, as long as broad, with more convex sides and dorsum, ventrally, in front, with a conspicuous rounded tubercle. Pygidium truncate, with finely spinulate border. Legs rather short, hind coxae with a rounded expansion at the tip on the inner side.

Moderately shining; mandibles very sparsely and coarsely punctate; body finely punctate, dorsal surfaces of head and thorax also with irregular scattered foveolae; region between the eyes and frontal carinae smooth and shining. Sides of head and thorax also more shining and less punctate.

Hairs and pubescence grayish, the hairs rather short, sparse, erect, both on the body and appendages, longest and most abundant at the tip of the gaster, the pubescence rather long and abundant, especially on the petiole, postpetiole, gaster, legs, and antennae, but also well-developed on the thoracic dorsum and head.

Black; mandibles, antennae, legs, pygidium, and sting dark red, the middle portions of the scapes, femora, and tibiae somewhat darker.

Female. Length 4 mm.

Very similar to the worker. Thorax through the wing-insertions as broad as the head; mesonotum small, flat, a little broader than long, shaped like an isosceles triangle, with the apex directed anteriorly. Sculpture, pilosity, and color as in the worker. Wings yellowish hyaline, with pale yellow veins and conspicuous brown pterostigma.

Described from four workers and three females taken by Mr. John Hewitt at Kuching. *Type.*— M. C. Z. 8,945.

This species seems to be closely related to *Ph. pubescens* Emery, described from a deälated female, but *hewitti* is much smaller (*pubes-*

cens measures about 6 mm.); the epinotal declivity is very distinctly separated from the base by a pronounced margination or carina, the petiole, and postpetiole are much broader and the former has distinctly dentate posterior angles.

*7a. MYOPOPONE CASTANEA Smith subsp. MACULATA Roger.

Myopopone maculata Roger, Berl. ent. zeitschr., 1861, **5**, p. 50, ☿ ♀.
Myopopone castanea Forel, Journ. Bombay nat. hist. soc., 1900, **13**, p. 54, ☿ ♀; Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 54.
Myopopone castanea subsp. *maculata* Emery, Gen. Ins. Ponerinae, 1911, p. 26.

Type-locality: Ceylon (☿) and Bintang Island (♀).

A single female from Kuching (John Hewitt), though measuring only 12.5 mm., agrees in all other respects with females from the Philippines. The tibiae are not spotted. The species has not been recorded from Borneo, though well known from other parts of the Malayan and Papuan regions.

*8. PLATYTHYREA PUSILLA Emery.

Platythyrea pusilla Emery, Rev. Suisse zool., 1893, **1**, p. 188, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 29, ☿.

Type-locality: Amboina.

A single deälated female from Kuching (John Hewitt) agrees well with Emery's description of the worker. It measures only 5 mm.

9. PLATYTHYREA SUBTILIS Emery.

Platythyrea subtilis Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 666, *nota* ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 29, ☿.

Type-locality: Pulo Laut, Borneo (Doherty).

10. STICTOPONERA BORNEËNSIS Emery.

Ectatomma coxale Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 150, ☿ (*nec* Roger).
Stictoponera borneënsis Emery, ibid., 1900, ser. 2, **20**, p. 662 *nota*, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 47, ☿.

Type-locality: Sarawak, Borneo.

Two workers from Kuching (John Hewitt).

11a. STICTOPONERA COSTATA Emery var. UNICOLOR Forel.

Stictoponera costata var. *unicolor* Forel, Rev. Suisse zool., 1901, **9**, p. 335, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 48, ☿.

Type-locality: Sarawak, Borneo (Haviland).

12. STICTOPONERA COXALIS (Roger).

Ponera coxalis Roger, Berl. ent. zeitschr., 1860, **4**, p. 308, ☿.
Ectatomma coxale Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 444.
Stictoponera coxalis Emery, ibid., 1900, ser. 2, **20**, p. 662; Emery, Gen. Ins. Ponerinae, 1911, p. 48.
Ectatomma (*Stictoponera*) *coxale* Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 84, ☿, fig. 44.

Type-locality: Ceylon (H. Nietner).
Sarawak (Doria and Beccari).

13. STICTOPONERA MENADENSIS Mayr.

Ectatomma (*Stictoponera*) *menadensis* Mayr. Verh. Zool. bot. gesellsch. Wien, 1887, **37**, p. 539 *nota* ☿.
Stictoponera menadensis Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 663; Emery, Gen. Ins. Ponerinae, 1911, p. 48, ☿.

Type-locality: Menado, Celebes (Radoszkowski).
Borneo.

A worker, which agrees very closely with Mayr's description, and three males from Kuching (John Hewitt). I refrain from describing the latter, as I am not certain that they belong with the worker.

14. STICTOPONERA RUGOSA (Smith).

Ponera rugosa Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 66, ☿.
Stictoponera rugosa Emery, Gen. Ins. Ponerinae, 1911, p. 48, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).

15. Rhopalopone diehli (Forel).

Ectatomma (*Mictoponera*) *diehli* Forel, Ann. Soc. ent. Belgique, 1901, **45**, p. 372, ☿.
Rhopalopone diehli Emery, Gen. Ins. Ponerinae, 1911, p. 35, ☿.

Type-locality: Sarawak, Borneo (Haviland).

16. Odontoponera transversa (Smith).

Ponera transversa Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 68, ☿; Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 86, ☿.
Ponera denticulata Smith, ibid., p. 90, ♀, pl. 6, fig. 13, 14.
Odontoponera denticulata Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 717.
Odontoponera transversa Dalla Torre, Cat. Hymenop., 1893, **7**, p. 30; Emery, Gen. Ins. Ponerinae, 1911, p. 60.

Type-locality: Singapore (A. R. Wallace).
Sarawak (Doria and Beccari).

Several specimens from Kuching (John Hewitt), Rambungan River, Sarawak (H. W. Smith) and British North Borneo (E. B. Kershaw). These and a series of specimens taken at Surubaya, Java, by H. W. Smith and by F. X. Williams in the Philippines vary considerably in size. Rather pronounced differences in color have also been noted by other authors, but no attempt has been made to name varieties.

17. Diacamma holosericeum (Roger).

Ponera holoserica Roger, Berl. ent. zeitschr., 1860, **4**, p. 302, ☿.
Diacamma holosericeum Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 149, ☿; Emery, ibid., 1887, ser. 2, **5**, p. 435, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 65.

Type-locality: Java.
Sarawak (Doria and Beccari).

18. Diacamma intricatum (Smith).

Ponera intricata Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 67, ☿.
Diacamma intricatum Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 149; Emery, Gen. Ins. Ponerinae, 1911, p. 65.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (J. Doria and O. Beccari); Kapouas Basin (Chaper); Central Borneo (Munich Museum).

Several workers taken at Kuching by John Hewitt and H. W. Smith and by the latter at Sadong, Serambu Mt., and Rambungan River, Sarawak.

*18a. DIACAMMA INTRICATUM subsp. KERSHAWI, subsp. nov.

Worker. Length about 11 mm.

Smaller than the typical *intricatum*, with smaller eyes, less pronounced clypeal carina, the petiole narrower anteriorly, and the striae on the upper surface of the petiole and first gastric segment almost obliterated. The second gastric segment is faintly, but distinctly, longitudinally striated in the middle above, and the whole gaster is more opaque and more densely punctate. The pilosity on the body and legs is slightly more abundant than in the typical form.

A single specimen taken by Mr. E. B. Kershaw in British North Borneo. *Type.*— M. C. Z. 9,073.

19. DIACAMMA RUGOSUM (Le Guillou).

Ponera rugosa Le Guillou, Ann. Soc. ent. France, 1840, **10**, p. 318, ☿.
Ponera versicolor Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 65, ☿.
Diacamma rugosum Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 149, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 66.
Diacamma geometricum subsp. *versicolor* Emery, Rev. Suisse zool., 1893, **1**, p. 189; Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 438.

Type-locality: Borneo. (Voyage of the "Astrolabe" and "Zelée").

Sarawak (Doria and Beccari; Bedot and Pictet; A. R. Wallace).

Eleven workers from Sadong, Sarawak (H. W. Smith) and two from Kuching (John Hewitt) agree with Emery's redescription of this species. They lack metallic reflections, however.

19a. DIACAMMA RUGOSUM subsp. TORTUOLOSUM (Smith).

Ponera tortuolosa Smith, Journ. Proc. Linn. soc. London. Zool., 1863, **7**, p. 18, ☿.
Diacamma tortuolosum Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 46, ☿.

Diacamma rugosum subsp. *tortuolosum* Emery, Rend. R. accad. sci. Bologna, 1897, 1896–97, n. s., **1**, p. 160; Emery, Gen. Ins. Ponerinae, 1911, p. 67.

Type-locality: Ceram (A. R. Wallace).

Tandjong, S. E. Borneo (Fritz Suck).

19b. DIACAMMA RUGOSUM subsp. GEOMETRICUM (Smith).

Ponera geometrica Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 67, ☿.

Diacamma geometricum Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 718, ☿.

Diacamma javanum Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 439, ☿.

Diacamma rugosum subsp. *geometricum* Emery, Rend. R. accad. sci. Bologna, 1897, 1896–97, n. s., **1**, p. 154, fig. 3, 8, 14, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 66, ☿.

Type-locality: Singapore (A. R. Wallace).

Banguey I., N. Borneo (Emery).

A worker and two males taken in British North Borneo (E. B. Kershaw). The male measures 8 mm., and is ferruginous red, with the posterior part of the head and some indistinct spots on the mesonotum dark brown. Wings slightly infuscated, with dark brown veins and pterostigma. Antennae very long (7 mm.), mandibles small, narrow, edentate, with acuminate, pointed tips. Petiole $1\frac{1}{4}$ times as long as broad, narrowed in front, but with very prominent stigmatic tubercles; in profile about as long as high, triangular, with sloping, slightly concave anterior and abrupt posterior surface and blunt apex. Pygidium small, bluntly rounded, cerci well-developed; genitalia partially exserted. Body shining, sparsely and finely punctate. Hairs brown, short, rather abundant, pubescence pale, more abundant, and like the hairs, on all parts of the body.

19c. DIACAMMA RUGOSUM subsp. VAGANS Smith var. BIRMANUM Emery.

Diacamma rugosum subsp. *vagans* var. *birmana* Emery. Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 441, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 67; Forel, Rev. Suisse zool., 1911, **19**, p. 23.

Diacamma rugosum subsp. *sculptum* var. *birmana* Emery, Rend. R. accad. sci. Bologna, 1897, 1896–97, n. s. **1**, p. 157, ☿.

Type-locality: Minhla, Burmah (Comotto).

Sarawak (Haviland).

20a. BOTHROPONERA INSULARIS Emery var. BREVIOR Forel.

Pachycondyla (*Bothroponera*) *insularis* v. *brevior* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 45, ☿ ; Emery, Gen. Ins. Ponerinae, 1911, p. 76.

Type-locality: Borneo.

21. BOTHROPONERA RUFIPES (Jerdon).

Ponera rufipes Jerdon, Ann. mag. nat. hist., 1854, ser. 2, **13**, p. 102, ☿ .
Pachycondyla rufipes Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 106, ☿ .
Bothroponera rufipes Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 359; Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿ .
Ponera (*Bothroponera*) *rufipes* Forel, Journ. Bombay nat. hist. soc., 1900, **13**, p. 323.
Pachycondyla (*Bothroponera*) *rufipes* Emery, Gen. Ins. Ponerinae, 1911, p. 76.

Type-locality: Malabar, Southern India (Jerdon).
Kapouas Basin, Borneo (Chaper).

22. BOTHROPONERA TRIDENTATA (Smith).

Pachycondyla tridentata Smith, Cat. Hymenop. Brit. mus. 1858, **6**, p. 106, ☿ .
Bothroponera tridentata Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 149; Emery, ibid., 1887, ser. 2, **5**, p. 442, ☿ .
Pachycondyla (*Bothroponera*) *tridentata* Emery, Gen. Ins. Ponerinae, 1911, p. 77.

Type-locality: Sarawak, Borneo.
Sarawak (Doria and Beccari).

23a. BOTHROPONERA TRIDENTATA subsp. DEBILIOR Forel.

Pachycondyla (*Bothroponera*) *tridentata* subsp. *debilior* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 46, ☿ ; Emery, Gen. Ins. Ponerinae, 1911, p. 77, ☿ .

Type-locality: Tandjong, S. E. Borneo (Fritz Suck).

24. ECTOMOMYRMEX OBTUSUS (Emery).

Pachycondyla (*Bothroponera*) *obtusa* Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 667 *nota* ☿ .

Pachycondyla (*Ectomomyrmex*) *obtusa* Emery, Gen. Ins. Ponerinae, 1911, p. 79, ☿.

Type-locality: Pulo Laut, Borneo (W. Doherty).

25. EUPONERA (BRACHYPONERA) LUTEIPES (Mayr).

Ponera luteipes Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 722, ☿ ♀; Forel, Journ. Bombay, nat. hist. soc., 1900, **13**, p. 326, ☿ ♀ ♂.
Euponera (*Brachyponera*) *luteipes* Emery, Ann. Soc. ent. Belgique, 1901, **45**, p. 47; Emery, Gen. Ins. Ponerinae, 1911, p. 84.
Brachyponera luteipes Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 101, ☿ ♀ ♂.

Type-locality: Milu, Nicobar Islands (Novara Expedition).
Sarawak (Haviland).

26a. EUPONERA (TRACHYMESOPUS) DARWINI Forel var. INDICA Emery.

Euponera (*Pseudoponera*) *darwini* var. *indica* Emery, Bull. Soc. ent. Ital., 1900, **31**, p. 268 *nota*, ♀.
Pseudoponera darwini Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 93.
Euponera (*Trachymesopus*) *darwini* var. *indica* Emery, Gen. Ins. Ponerinae, 1911, p. 86.

Type-locality: Upper Burmah (Doherty).
Sarawak (Haviland, Will).

27. PONERA TRUNCATA Smith.

Ponera truncata Smith, Journ. Proc. Linn. soc. London. Zool. Suppl., 1860, **4**, p. 72, ♀; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 150, ♀; Emery, Gen. Ins. Ponerinae, 1911, p. 92, ♀.

Type-locality: Celebes.
Sarawak (Doria and Beccari).

Two deälated females from Sarawak (H. W. Smith) seem to be referable to this species, but are only 3–3.5 mm. long, whereas the dimensions of the female cotypes are given by Mayr as 4–4.2 mm. My specimens may represent a distinct variety or subspecies, but it seems inadvisable to introduce another name on the basis of such meager material.

*28. Ponera gleadowi Forel.

Poneragleadowi Forel, in Emery, Mem. R. accad. sci. Bologna, 1896, 1895-1896, ser. 5, **5**, p. 292 *nota* ☿ ; Emery, ibid., p. 297, fig. 17a, b, c; Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 91; Emery, Gen. Ins. Ponerinae, 1911, p. 91.

Type-locality: Poona, India (Wroughton).

Two workers from Sarawak (H. W. Smith) agree very closely with a typical specimen from Orissa received from Professor Forel. The species has a wide distribution, occurring as far north and west as Algeria.

*29a. Ponera confinis Roger var. javana Forel.

Ponera confinis var. *javana* Forel, Mitth. Naturh. mus. Hamburg, 1905, **22**, p. 6, ☿ ♀ ; Emery, Gen. Ins. Ponerinae, 1911, p. 90, ☿ ♀.

Type-locality: Buitenzorg, Java (K. Kraepelin).

Seven workers and two females from Kuching (John Hewitt) agree well with a specimen from Singapore given me by Forel, with the description of specimens from Buitenzorg and with a worker taken by H. W. Smith at Surubaya, Java.

30. Leptogenys (Lobopelta) chalybea Emery.

Lobopelta iridescens Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 150, ☿ ; Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 665, ☿ (*nec* Smith).
Lobopelta chalybea Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 432, ☿.
Leptogenys (*Lobopelta*) *chalybea* Emery, Gen. Ins. Ponerinae, 1911, p. 102, ☿.

Type-locality: Sarawak, Borneo (Doria and Beccari).

Four workers from Kuching (John Hewitt).

31. Leptogenys (Lobopelta) iridescens (Smith).

Ponera iridescens Smith, Journ. Proc. Linn. Soc. London. Zool., 1857, **2**, p. 66, ☿.
Lobopelta iridescens Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 431, ☿.
Leptogenys (*Lobopelta*) *iridescens* Emery, Gen. Ins. Ponerinae, 1911, p. 104, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari, Haviland).

A dozen workers from Kuching (H. W. Smith).

31a. LEPTOGENYS (LOBOPELTA) IRIDESCENS subsp. CURRENS Forel.

Leptogenys (*Lobopelta*) *iridescens* subsp. *currens* Forel, Rev. Suisse zool., 1901, **9**, p. 329, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 104, ☿.

Type-locality: Sarawak, Borneo (Haviland).

32. LEPTOGENYS (LOBOPELTA) MUTABILIS (Smith).

Ponera mutabilis Smith, Journ. Proc. Linn. Soc. London. Zool., 1861, **6**, p. 45, ☿.
Lobopelta mutabilis Mayr, Tijdschr. ent. 1867, **10**, p. 89; Emery, Ann.Mus. civ. Genova, 1887, ser. 2, **5**, p. 30, ☿.
Leptogenys (*Lobopelta*) *mutabilis* Emery, Gen. Ins. Ponerinae, 1911, p. 104.

Type-locality: Tondano, Celebes (A. R. Wallace).
Sarawak, Borneo (Doria and Beccari; Bedot and Pictet).

Eleven workers from British North Borneo (E. B. Kershaw) and two from Kuching (H. W. Smith).

33a. LEPTOGENYS (LOBOPELTA) PROCESSIONALIS Jerdon var. DISTINGUENDA Emery.

Lobopelta distinguenda Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 430, ☿.
Lobopelta mutabilis (part) Mayr, ibid., 1872, **2**, p. 151, ☿.
Leptogenys (*Lobopelta*) *ocellifera* subsp. *distinguenda* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 46, ☿.
Leptogenys (*Lobopelta*) *processionalis* var. *distinguenda* Emery, Gen. Ins. Ponerinae, 1911, p. 104.

Type-locality: Sarawak, Borneo (Doria and Beccari).
Tandjong, S. E. Borneo (Fritz Suck).
Two dozen workers from Kuching (H. W. Smith).

34. LEPTOGENYS (LOBOPELTA) DIMINUTA (Smith).

Ponera diminuta Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 69, ☿.
Lobopelta diminuta Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 734, ☿.
Leptogenys diminuta Forel, Journ. Bombay nat. hist. soc., 1900, **13**, p. 312.
Leptogenys (*Lobopelta*) *diminuta* Emery, Gen. Ins. Ponerinae, 1911, p. 103.

Type-locality: Sarawak, Borneo (A. R. Wallace).
S. E. Borneo (Fritz Suck).

34a. Leptogenys (Lobopelta) diminuta var. laeviceps (Smith).

Ponera laeviceps Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 69, ☿.
Ponera simillima Smith, ibid., 1861, **5**, p. 105, ☿.
Lobopelta diminuta var. *laeviceps* Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 433, ☿.
Leptogenys (*Lobopelta*) *diminuta* var. *laeviceps* Emery, Gen. Ins. Ponerinae, 1911, p. 103.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Two workers from Kuching (John Hewitt).

*35. Leptogenys (Lobopelta) borneënsis, sp. nov.

Worker. Length: 9 mm.

Long and slender. Head about $\frac{1}{5}$ longer than broad, a little broader in front than behind, with nearly straight sides in front, rounded behind, with rather deeply excavated occipital border. Eyes rather small, situated a distance equal to their length from the anterior corners of the head. Mandibles rather large, triangular, with deflected tips, distinctly concave lateral, dentate apical and denticulate basal borders. Clypeus strongly carinate, its anterior border entire, projecting as a membranous, rather narrowly rounded lobe. Antennae long and slender; scapes extending about $\frac{1}{4}$ their length beyond the posterior corners of the head; all the funicular joints much longer than broad; first joint a little more than half as long as the second, second slightly longer than the third. Thorax long and slender. Pronotum slightly flattened above, longer than broad, mesonotum shorter and much narrower and lower than the pronotum, its dorsal outline very feebly concave; epinotum scarcely broader than the mesonotum, but very distinctly higher and longer, the base straight and horizontal, twice as long as the vertical declivity into which it passes through a curve without any trace of an angle. The sides of the declivity are feebly marginate. Each epinotal stigma is situated in a sharply defined elliptical depression. Petiole from above fully twice as long as broad, narrowed in front, laterally compressed. In profile the node is longer than high, its anterior border long and convex, the posterior border straight, the apex blunt, the ventral surface of the petiole sinuous in the middle. Gaster small. Legs long and slender.

Shining, very sparsely and very finely punctate; mandibles very finely and densely striate.

Hairs whitish, short, sparse, and erect on the body, more abundant and more oblique on the appendages. Pubescence pale, present only on the funiculi and tarsi.

Castaneous; mandibles, clypeus, legs including coxae, neck, prosterna petiole and tip of gaster, red; posterior margins of gastric segments yellowish.

Described from a single specimen taken at Kuching by Mr. John Hewitt.

This species has much the same color as *iridescens* apart from the blue reflections, but the shape of the node and thorax serve to distinguish it at once.

36a. LEPTOGENYS (LOBOPELTA) KITTELI Mayr subsp. LAEVIS Mayr.

Lobopelta kitteli var. *laevis* Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 665, ☿.

Leptogenys (*Lobopelta*) *kitteli* subsp. *laevis* Forel, Rev. Suisse zool., 1901, **9**, p. 329, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 104.

Type-locality: Java.

Sarawak (Haviland).

37. ODONTOMACHUS HAEMATODA (Linné).

Formica haematoda Linné, Syst. nat., ed. 10, 1758, p. 582, ☿.

Myrmecia unispinosa Fabricius, Syst. Piez., 1804, p. 423, ☿.

Myrmecia haematoda Fabricius, Syst. Piez., 1804, p. 423, ☿.

Odontomachus haematodes Latreille, Hist. nat. Crust. Ins., 1805, **13**, p. 257.

Ponera (*Odontomachus*) *haematoda* Latreille, ibid., 1809, **4**, p. 128, ☿.

Odontomachus haematoda Dalla Torre, Cat. Hymenop., 1893, **7**, p. 50; Emery, Gen. Ins. Ponerinae, 1911, p. 114, pl. 3, fig. 18, ☿ ♀ ♂.

Formica maxillosa DeGeer, Mem. hist. ins., 1773, **3**, p. 601, ☿, pl. 31, fig. 3–5.

Formica unispinosa Fabricius, Ent. syst., 1793, **2**, p. 359, ☿.

Odontomachus simillimus Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 80, pl. 5, fig. 8, 9.

Type-locality: South America (Rolander).

Sarawak (Doria and Beccari), Kapouas Basin (Chaper).

Two workers from Kuching (John Hewitt).

38. ODONTOMACHUS RIXOSUS Smith.

Odontomachus rixosus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 67, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 114.

Type-locality: Singapore (A. R. Wallace).

Sarawak (J. Doria and O. Beccari); Kapouas Basin (Chaper).
A dozen workers from Kuching (H. W. Smith).

39. ODONTOMACHUS MALIGNUS Smith.

Odontomachus malignus Smith, Journ. Proc. Linn. soc. London. Zool., 1859, **3**, p. 144, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 113.
Odontomachus tuberculatus Roger, Berl. ent. zeitschr., 1861, **5**, p. 28, ☿; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 149, ☿.

Type-locality: Aru (A. R. Wallace).
Sarawak, Borneo (Doria and Beccari).

40. ANOCHETUS AGILIS Emery.

Anochetus agilis Emery, Ann. Soc. ent. Belgique, 1901, **45**, p. 53, ☿; Emery, Gen. Ins. Ponerinae, 1911, p. 108.

Type-locality: Banguey, Borneo (Staudinger and Bang-Haas).

DORYLINAE.

41. DORYLUS (DICHTHADIA) LAEVIGATUS (Smith).

Typhlopone laevigatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 70, ☿.
Dichthadia glaberrima Gerstäcker, Stettin. ent. zeit., 1863, **24**, p. 93, ♀.
Dorylus klugi Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 448, pl. 1, fig. 10, ♂.
Dorylus laevigatus Emery, Zool. jahrb. Syst., 1895, **8**, p. 729, ☿.
Dorylus (*Dichthadia*) *laevigatus* Emery, Gen. Ins. Dorylinae, 1910, p. 8, ☿ ♀ ♂.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Doria and Beccari).
Two large workers from Kuching (John Hewitt).

42. AENICTUS LAEVICEPS (Smith).

Typhlatta laeviceps Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 79, ☿.
Aenictus laeviceps Forel, Ann. Soc. ent. Belgique, 1890, **34**, C. R., p. CII, ☿; Emery, Gen. Ins. Dorylinae, 1910, p. 30, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Doria and Beccari).
Five workers from Bongo Mt., Borneo (Hewitt and Brooks).

43. AENICTUS GRACILIS Emery.

Aenictus gracilis Emery, Rev. Suisse zool., 1893, **1**, p. 187, ☿; Emery, Gen. Ins. Dorylinae, 1910, p. 30, ☿.

Type-locality: Sarawak (Bedot and Pictet).

44. AENICTUS CORNUTUS Forel.

Aenictus cornutus Forel, Ann. Soc. ent. Belgique, 1900, **44**, p. 75, ☿; Emery, Gen. Ins. Dorylinae, 1910, p. 29, ☿.

Type-locality: Sarawak (Haviland).
A single worker from Kuching (John Hewitt).

45. AENICTUS PUNCTIVENTRIS Emery.

Aenictus punctiventris Emery, Bull. Soc. ent. Ital., 1901, **33**, p. 47, ♂; Emery, Gen. Ins. Dorylinae, 1910, p. 31, ♂.

Type-locality: Borneo.
A single worker from Kuching (John Hewitt).

46. AENICTUS AITKENI Forel.

Aenictus aitkeni Forel, Journ. Bombay nat. hist. soc. 1901, **13**, p. 465, 475, ☿; Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 19, fig. 18, ☿; Emery, Gen. Ins. Dorylinae, 1910, p. 29, ☿.

Type-locality: Kanara, India (Aitken).
Sixteen workers from Kuching (H. W. Smith).

MYRMICINAE.

*47. METAPONE HEWITTI, sp. nov.

Male. Length 6–7 mm.

Body long and slender. Head as broad as long, evenly convex and rounded behind, without posterior corners; cheeks very short; eyes moderately large, but not very convex; ocelli rather small. Mandibles small, but well-developed, their external borders slightly sinuate towards the base, convex at the tips; apical and basal borders distinct, subequal, the former with four subequal teeth. Clypeus large, convex, somewhat broader than long, slightly depressed or flattened posteriorly. Front truncated anteriorly, with a transverse crest or carina separating it from the preocellar space and connecting the frontal carinae, which are prominent, nearly straight, subparallel and as far apart as they are from the lateral borders of the head. Posteriorly each carina curves forward medially to the eye as a distinct ridge and terminates opposite its anterior end, thus enclosing a small, shallow, elliptical scrobe about the base of the antenna. Antennae 12-jointed, scape very small, about twice as long as broad, first funicular joint also very small, broader than long, subglobular; second joint longer but also broader than long, the remaining nine joints cylindrical, of equal breadth, distinctly longer than broad and gradually increasing in length distally; terminal joint nearly as long as the two preceding joints together, with tapering and somewhat pointed tip. Thorax long, narrower than the head through the eyes. Pronotum well-developed, truncated in front; mesonotum and scutellum somewhat flattened above, the former with distinct Mayrian furrows, the latter with a peculiar blunt, spatulate spine on each side, slightly curved inward at its tip. Epinotum longer than broad, subrectangular from above, its base horizontal and twice as long as the vertical declivity into which it passes through an abrupt curve, the sides of the declivity above and of the base coarsely and rather irregularly marginate. Petiole with a short, stout peduncle anteriorly and a thick, cuboidal node, which is a little longer than broad and slightly higher in front than behind, with truncated anterior and posterior and feebly rounded dorsal and lateral surfaces. Seen in profile its ventral margin is slightly bisinuate, with a small, triangular tooth at the anterior end of the peduncle. Postpetiole distinctly broader than the petiole and broader than long, from above transversely elliptical, in profile slightly truncated anteriorly, convex and rounded above, its ventral border unarmed, nearly straight. Gaster elongate elliptical, with straight anterior border and tapering tip. Genitalia completely retracted, cerci apparently absent; pygidium and hypopygium short and pointed. Legs short, of the usual simple form, without the tibial spines of the worker and female; spurs of the middle and hind tibiae simple, blunt at the tip. Tarsal claws very small, strongly curved, nonpectinated. Wings very short (4.5 mm.), with a well-developed discoidal cell, a single cubital cell and the radial cell slightly open at the tip. The radial cell is large. Pterostigma well-developed and conspicuous.

Subopaque; mandibles opaque, longitudinally rugose and very finely punctate. Head reticulate-rugose, the clypeus more coarsely and transversely. Front behind its anterior truncation with regular longitudinal rugae converging to the anterior ocellus. Antennal scrobes less distinctly longitudinally rugose. Upper surface of mesonotum and scutellum and sides of thorax sharply and regularly longitudinally rugose, with elongate, shallow foveolae in the narrow interrugal spaces on the mesonotum. Dorsal surface of epinotum, including the upper portion of the declivity, with extremely coarse reticulate rugae, some of which are clearly transverse. Petiole above less coarsely and even more irregularly rugose. Postpetiole and gaster very finely and densely punctate, with superimposed small, sparse, and very regular piligerous punctures.

Hairs grayish brown, short, rather abundant, erect on the head, thorax, and petiole, mostly subappressed or oblique on the postpetiole, gaster, and legs. Antennal funiculi with very short, fine hairs, or pubescence. Wings minutely hairy.

Black; mandibles, antennae, legs, and tip of gaster reddish brown, the tarsi slightly paler. Wings grayish hyaline, with slightly infuscated tips and anterior margin; veins sharply defined, brown; pterostigma dark brown.

Described from four specimens taken by Mr. John Hewitt at Kuching in 1908. *Type.*— M. C. Z. 8,946.

I have described this male in detail and given it a name, although in closely resembles the male of *M. greeni* Forel from Ceylon, described from a mature pupa, because no adult winged male of the genus has been described. The Bornean specimens may belong to a different species, possibly *M. sauteri* Forel of Formosa or *M. bakeri* Wheeler of the Philippines, both known only from females. It can hardly be the male of the only other known species of *Metapone*, *M. mjöbergi* Forel of Queensland. The four specimens of *M. hewitti* have been in my collection for many years and were placed provisionally with Cataulacus. Forel's very careful description and figures (Rev. Suisse zool., 1911, **19**, pl. 14) finally enabled me to recognize them as Metapone males. Forel is, I believe, in error in stating that the antennae of the male *M. greeni* are 11-jointed. He has apparently overlooked the second funicular joint. As Green has shown, the species of this extraordinary genus nest in decayed branches. He found the types of *M. greeni* and their larvae in company with termites.

48. TETRAPONERA NIGRA (Jerdon).

Eciton nigrum Jerdon, Madras journ. lit. sci., 1851, **17**, p. 112, ☿.

Tetraponera atrata Smith, Ann. mag. nat. hist., 1852, ser. 2, **9**, p. 44, ☿; Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 70, ♀.

Pseudomyrma nigra Smith, Cat. Hymenop., Brit. mus., 1858, **6**, p. 159, ☿.

Pseudomyrma atrata Smith, ibid. p. 159.

Pseudomyrma carbonaria Smith, Journ. Proc. Linn. soc. London Zool., 1863, **7**, p. 20, ☿ ♀.

Sima nigra Emery in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 54.

Type-locality: Malabar, Southern India (Jerdon).
Sarawak (A. R. Wallace).

49. TETRAPONERA ATTENUATA Smith.

Tetraponera attenuata Smith, Trans. Ent. soc. London, 1877, p. 71, ☿.
Sima attenuata Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿.
Sima (*Tetraponera*) *attenuata* var. *tenuissima* Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 675, ☿ ♀, fig. 5b.

Type-locality: Sarawak.
Kapouas Basin (Chaper); Tandjong, S. E. Borneo (Fritz Suck).
A single worker from Kuching (John Hewitt).

*50. TETRAPONERA DIFFICILIS Emery.

Sima (*Tetraponera*) *difficilis* Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 676, ☿.

Type-locality: Benculen, Sumatra (E. Modigliani).
Six workers from Kuching (John Hewitt).

51. TETRAPONERA PILOSA (Smith).

Pseudoponera pilosa Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 160, ☿.
Sima pilosa Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 449 *nota;* Emery, ibid., 1900, ser. 2, **20**, p. 675.

Type-locality: Borneo.
Two workers and a deälated female from Kuching (John Hewitt).

52. MYRMICA RITAE Emery.

Myrmica ritae Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 501, ☿, pl. 11, fig. 27; ibid., 1894, ser. 2, **14**, p. 451, ☿.

Type-locality: Mt. Mooleyit (1,000–1,900 m.), Tenasserim (L. Fea).
Pulo Laut, Borneo (W. Doherty).

*53. PHEIDOLE MEGACEPHALA (Fabricius).

Formica megacephala Fabricius, Ent. syst., 1793, **2**, p. 361, ♃.
Formica (*Myrmica*) *trinodis* Losana, Mem. Accad. sci. Turino, 1834, **37**, p. 327, pl. 36, fig. 6.

Oecophthora pusilla Heer, Hausameise Madeiras, 1852, p. 15, ♃ ☿ ♀ ♂, pl. 1, fig. 1–4.

Myrmica? laevigata Smith, Trans. Ent. soc. London, 1855, ser. 2, **3**, p. 130, ☿, pl. 9, fig. 7, 8.

Myrmica trinodis Mayr. Verh. Zool. bot. gesellsch. Wien, 1855, **5**, p. 414, *nota*, ☿.

Myrmica (*Pheidole*) *laevigata* Smith, Cat. Brit. fossor. Hymenop., 1858, p. 35, 225, ☿.

Pheidole pusilla Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 173, pl. 9, fig. 18–20.

Pheidole janus Smith, ibid., p. 175, ♀, pl. 9, fig. 13–17.

Pheidole megacephala Roger, Verzeich. formicid., 1863, p. 30; Dalla Torre, Cat. Hymenop., 1893, **7**, p. 92.

Type-locality: Mauritius (Coll. Bosc).

Numerous soldiers and workers from Kuching (John Hewitt and H. W. Smith).

54. Pheidole javana Mayr.

Pheidole javana Mayr, Tijdschr. ent., 1867, **10**, p. 98, ♃ ☿.

Type-locality: Java.

Sarawak (Doria and Beccari; Bedot and Pictet); Kapouas Basin (Chaper).

Two soldiers and several workers from Kuching (John Hewitt) and Sarawak (H. W. Smith).

*55. Pheidole bugi, sp. nov.

Soldier. Length 2 mm.

Head large, subrectangular, longer than broad, with nearly straight subparallel sides, slightly narrowed at the posterior corners, with deeply and angularly excised occipital border, distinctly depressed in the occipital region and with distinct occipital groove. Eyes small, with angular inferior orbits, situated at the anterior fourth of the head. Mandibles large, convex, with broad apical margins, furnished at their tips with a pair of large, blunt teeth. Clypeus flattened, or slightly concave in the middle, ecarinate, its anterior border deeply notched. Frontal area distinct, semicircular, impressed. Frontal carinae rather short, diverging behind and bordering flattened, indistinct scrobe-like areas. Antennae short and slender, the scapes reaching the lateral borders of the head a little behind the eyes and in front of the middle;

joints 2–7 of the funiculi distinctly broader than long; club somewhat longer than the remainder of the funiculus. Thorax robust, the pronotum broad and convex, its humeri protruding as bluntly rounded angles; mesonotum sloping, with a transverse torus in the middle. Epinotum low, its base in profile straight and longer than the declivity; the spines short, rather erect, much shorter than the base of the epinotum and shorter than their distance apart at their insertions. Petiole short, the anterior slope of the node very concave, its summit blunt, transverse, and rather deeply emarginate, its posterior slope abrupt. Postpetiole slightly broader than the petiole, transverse, very convex above, broader in front than behind, the sides rounded. Gaster broadly elliptical, flattened, smaller than the head, with straight anterior border. Legs with stout, slightly swollen femora.

Somewhat shining; mandibles smooth, minutely and sparsely punctate. Clypeus smooth and shining in the middle, rugose on the sides; remainder of head sculptured, the anterior $\frac{2}{3}$ longitudinally rugose, with feebly reticulate interrugal areas, especially on the sides, the posterior third reticulately rugose, the scrobe-like areas densely punctate. Neck, pronotum, and mesonotum more finely reticulate-rugose; epinotum smooth and shining; petiole and postpetiole subopaque, indistinctly and very finely punctate or alutaceous. Gaster and legs smooth and shining, sparsely and finely punctate.

Hairs yellow, erect or suberect, coarse, rather long, of uneven length, more abundant on the body than on the appendages.

Ferruginous; gaster darker, brown; legs and antennae paler, more yellowish; borders of mandibles and clypeus blackish.

Worker. Length 1.4 mm.

Head $\frac{1}{5}$ longer than broad, subrectangular, with very feebly convex sides and feebly sinuate posterior border, as broad in front as behind. Eyes very small, at the middle of the sides of the head. Mandibles with oblique apical margins furnished with four acute, subequal teeth. Clypeus short, convex, its anterior border broadly rounded, entire. Antennal scapes reaching the posterior border of the head. Thorax rather slender; pro- and mesonotum fused, feebly rounded above and on the sides; mesoëpinotal constriction short and deep. Epinotum with subequal base and declivity, the spines reduced to small, rather blunt teeth, not longer than broad at their bases. Superior border of petiolar node transverse and entire. Postpetiole much as in the soldier.

Smooth and shining; mesopleurae and sides of epinotum densely punctate; petiolar and postpetiolar nodes subopaque.

Hairs whitish, erect, more uniform and somewhat more abundant than in the soldier, especially on the legs and scapes.

Yellowish brown; head and gaster a little darker; thorax and appendages paler and more yellowish.

Described from a single soldier and four workers from Sarawak, (Roland Thaxter). *Type.*— M. C. Z. 8,947.

This species is evidently related to *Ph. nodgii* Forel of Java, but the soldier is smaller, with more deeply notched clypeus, much less distinct antennal scrobes, shorter epinotal spines, more deeply notched petiolar node, laterally less angular postpetiole, and very different thoracic sculpture. The worker *bugi* is also smaller than that of *nodgii,* has a more elongate head, very feebly armed epinotum, a more rounded postpetiole, and very different sculpture.

56. PHEIDOLE ARISTOTELIS Forel.

Pheidole aristotelis Forel, Rev. Suisse zool., 1911, **19**, p. 43, ♃ ☿ ♂.

Type-locality: Sarawak, Borneo (Haviland).

57. PHEIDOLE COMATA Smith.

Pheidole comata Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 176, ☿ ; Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 360.

Type-locality: Sarawak, Borneo.

58. PHEIDOLE HAVILANDI Forel.

Pheidole havilandi Forel, Rev. Suisse zool., 1911, **19**, p. 38, ♃ ☿ ♀ ♂.

Type-locality: Sarawak, Borneo (Haviland).

59a. PHEIDOLE SAUBERI Forel subsp. SARAWAKANA Forel.

Pheidole sauberi subsp. *sarawakana* Forel, Rev. Suisse zool., 1911, **19**, p. 45, ♃ ☿ .

Type-locality: Sarawak, Borneo (Haviland).

60. ISCHNOMYRMEX LONGIPES (Smith).

Myrmica longipes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 70, ☿ , pl. 1, fig. 6.

Myrmica (Monomorium) longipes Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 126, ☿ .

Ischnomyrmex longipes Mayr, Tijdschr. ent., 1867, **10**, p. 60, ☿ ; Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿ .
Aphaenogaster longipes Emery, Ann. Mus. civ. Genova, 1888, ser. 2, **5**, p. 531, ☿ , pl. 9, fig. 2.
Aphaenogaster (*Ischnomyrmex*) *longipes* Forel, Rev. Suisse zool., 1911, **19**, p. 24, ☿ .
Pheidole (*Isopheidole*) *longipes* Forel, Rev. Suisse zool., 1912, **20**, p. 765, ♃ ☿ .
Pheidole (*Ischnomyrmex*) *longipes* Forel, Zool. jahrb. Syst., 1913, **36**, p. 49, ♃ ♀, fig. N.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Haviland); Kapouas Basin (Chaper).

Nine workers from the Rambungan River, Sarawak (H. W. Smith) and one from Kuching (John Hewitt).

61. MYRMICARIA CARINATA (Smith).

Heptacondylus carinatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 73, ☿ .
?*Physatta dromedarius* Smith, ibid., p. 78, ♀ .
Myrmicaria carinata Dalla Torre, Cat. Hymenop., 1893, **7**, p. 155.
Myrmicaria fodiens race *carinata* Emery, Rev. Suisse zool., 1893, **1**, p. 219.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Tandjong, S. E. Borneo (Fritz Suck).

Two workers and two males from Kina Balu, N. Borneo, obtained from Staudinger. The worker has the gaster distinctly striated at the base. This character, not mentioned by Smith, nevertheless exists in the type (*teste* W. F. Kirby) and is regarded by Emery as distinctive of the species.

*61a. MYRMICARIA CARINATA subsp. GAGATINA, subsp. nov.

Worker. Length 5.7 mm.

The series of small angles formed by the lateral carinae of the meso- and epinotum are somewhat more acute than in the typical form and the body is much smoother and more shining. There are only a few delicate longitudinal rugae on the head, some confined to the sides and just below and above the eyes and some abbreviated and widely separated on the posterior portion of the head. On the thorax the rugae are also finer, more regular and further apart. The extreme base of the gaster is finely striated as in typical *carinata.*

The color, however, is very different, the body being jet black, with the mandibles, antennae, legs, neck, and articulations of the pedicel dark reddish brown. The hairs covering the body and appendages are very dark brown, almost black.

Described from a single worker taken by Mr. G. E. Bryant on Matang Mt., West Sarawak and sent me by Mr. Horace Donisthorpe.

62. MYRMICARIA SUBCARINATA (Smith).

Heptocondylus subcarinatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 73, ☿.

Physatta gibbosa Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 172, ♀.

Heptacondylus dromedarius Mayr, Verh. Zool. bot. gesellsch. Wien., 1862, **12**, p. 757, ☿ (*nec* Smith).

Myrmicaria subcarinata Mayr, Tijdschr. ent., 1867, **10**, p. 112, ☿ ♀.

Myrmicaria fodiens race *subcarinata* Emery, Rev. Suisse zool., 1893, **1**, p. 219.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari; Haviland); Kapouas Basin (Chaper); Tandjong (Fritz Suck).

Two workers from British North Borneo (E. B. Kershaw).

63. MYRMICARIA RUGOSA (Smith).

Heptacondylus rugosus Smith, Journ. Proc. Linn. soc. London. Zool. Suppl., 1860, **4**, 110, ☿.

Myrmicaria (Heptacondylus) rugosus Smith, ibid., 1864, **8**, p. 73, ☿ ♀ ♂.

Myrmicaria rugosa Mayr, Tijdschr. ent. 1867, **10**, p. 113, ☿.

Type-locality: Batjan (A. R. Wallace).

Tandjong, S. E. Borneo (Fritz Suck).

64. MYRMICARIA ARACHNOIDES (Smith).

Heptacondylus arachnoides Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 72, ☿ ♀.

Heptacondylus longipes Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 142, ☿.

Myrmicaria longipes Mayr, Tijdschr. ent., 1867, **10**, p. 113, ☿ ♀ ♂.

Myrmicaria arachnoides Emery, in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 155.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Tandjong, S. E. Borneo (Fritz Suck); Kapouas Basin (Chaper); Sarawak (Doria and Beccari).

A male, female, and worker from Kuching (John Hewitt) and a male and a dozen workers from the same locality (H. W. Smith). Hewitt's specimens are accompanied by two of the peculiar nests of this ant, which consist of coarse, fibrous carton, built in the form of a series of contiguous and rather irregular chambers on the under surfaces of large leaves. One of the nests is 9 cm. long, 5 cm. broad and 2–3 cm. high, the other 8 cm. long, 4 cm. broad and 2 cm. high. These nests have been observed by Jacobson and von Buttel Reepen in Java and are briefly described by Forel (Notes of the Leyden mus., 1909, **31**, p. 252 and Zool. jahrb. Syst., 1913, **36**, p. 73).

*64a. Myrmicaria arachnoides subsp. melanogaster Emery.

Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 692 *nota*, ☿.
Forel, Rev. Suisse zool., 1911, **19**, p. 23, ☿ ♀ ♂.

Type-locality: Sarawak, Borneo.
Sarawak (Haviland); Hayvep (Zimmer).

*65. Cardiocondyla nuda (Mayr).

Leptothorax nudus Mayr, Sitzb. Akad. wiss. Wien, 1866, **53**, p. 508, ☿.
Cardiocondyla nuda Forel, Mitth. Münch. ent. ver. 1881, **5**, p. 3, ☿.

Type-locality: Ovalau, Fiji (Mus. Godeffroy).
A single worker from Sarawak (H. W. Smith).

66. Crematogaster brunnea Smith.

Crematogaster brunneus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 75, ☿
Cremastogaster brunnea Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 360, ☿.
Cremastogaster brunea Dalla Torre, Cat. Hymenop., 1893, **7**, p. 80.

Type-locality: Sarawak, Borneo (A. R. Wallace).
A single worker from Sarawak (H. W. Smith) agrees well with Smith's description of the worker minor of this species although the

color is somewhat darker. Unfortunately the thorax is somewhat crushed so that its precise form cannot be determined.

67. CREMATOGASTER CEPHALOTES Smith.

Crematogaster cephalotes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 75, ☿ (*nec* Gerstaecker).
Cremastogaster cephalotes Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Kapouas Basin (Chaper).

68. CREMATOGASTER CORIARIA Mayr.

Cremastogaster coriaria Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 154, ☿; Emery, ibid., 1887, ser. 2, **5**, p. 467, ☿.

Type-locality: Sarawak, Borneo (Doria and Beccari).

69a. CREMATOGASTER EGIDYI Forel subsp. SPINOZAE Forel.

Cremastogaster egidyi subsp. *spinozai* Forel, Rev. Suisse zool., 1911, **19**, p. 25, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).

69b. CREMATOGASTER EGIDYI subsp. SPINOZAE var. HAYVEPANA Forel.

Cremastogaster egidyi subsp. *spinozai* var. *hayvepana* Forel, Rev. Suisse zool., 1911, **19**, p. 26, ☿ ♀.

Type-locality: Hayvep, Borneo (Winkler).

70. CREMATOGASTER FERRARII Emery.

Cremastogaster ferrarii Emery, Ann. Mus. civ. Genova, 1888, ser. 2, **5**, p. 533, ☿; Emery, Rev. Suisse zool., 1893, **1**, p. 193.

Type-locality: Siboga, Sumatra (E. Modigliani).

Sarawak, Borneo (Bedot and Pictet).

71. CREMATOGASTER FRAXATRIX Forel.

Cremastogaster fraxatrix Forel, Rev. Suisse zool., 1911, **19**, p. 28, ☿.

Type-locality: Sarawak, Borneo (Haviland).

72. CREMATOGASTER INNOCENS Forel.

Cremastogaster innocens Forel, Rev. Suisse zool., 1911, **19**, p. 30, ☿ ♀.

Type-locality: Hayvep, Borneo (Winkler).

73. CREMATOGASTER LONGIPILOSA Forel.

Cremastogaster longipilosa Forel, Ann. Mus. nat. Hungar., 1907, **5**, p. 24, ☿; Forel, Rev. Suisse zool., 1911, **19**, p. 24, ☿.

Type-locality: Kwala Lampur, Malacca (Biro).
Sarawak, Borneo (Haviland).
Eleven workers from Sarawak (H. W. Smith; Roland Thaxter).

74. CREMATOGASTER MODIGLIANII Emery.

Crematogaster modiglianii Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 688, ☿.

Type-locality: Sipora, Mentawei (E. Modigliani).
Banguey, Borneo (Coll. Emery).

74a. CREMATOGASTER MODIGLIANII var. SARAWAKANA Forel.

Cremastogaster modiglianii v. *sarawakana* Forel, Rev. Suisse zool., 1911, **19**, p. 25, ☿.

Type-locality: Sarawak, Borneo (Haviland).
Ten workers from the Rambungan River, Sarawak (H. W. Smith).

75. CREMATOGASTER MYOPS Forel.

Cremastogaster myops Forel, Rev. Suisse zool., 1911, **19**, p. 31, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).

76. CREMATOGASTER OBSCURA Smith.

Crematogaster obscura Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 76, ☿; Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 137, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).

77a. CREMATOGASTER ROGENHOFERI Mayr var. FICTRIX Forel.

Cremastogaster rogenhoferi var. *fictrix* Forel, Rev. Suisse zool., 1911, **19**, p. 27, ☿.

Type-locality: Sarawak, Borneo (Haviland).

78. CREMATOGASTER SUBCIRCULARIS Mayr.

Cremastogaster anthracina Mayr, Tijdschr. ent., 1867, **10**, p. 75, ☿; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 154 (*nec* Smith).
Cremastogaster subcircularis Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 681, 685, ☿; Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 467, ☿.

Type-locality: Borneo (Doria and Beccari).

79. CREMATOGASTER SUBNUDA Mayr.

Cremastogaster subnuda Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 680, 682, ☿; Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿.

Type-locality: Calcutta, India.
Kapouas Basin, Borneo (Chaper).

80. CREMATOGASTER (PHYSOCREMA) DIFORMIS Smith.

Crematogaster difformis Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 76, ☿.
Crematogaster ampullaris Smith, ibid., 1861, **6**, p. 47, ☿.
Cremastogaster difformis Mayr, Tijdschr. ent., 1867, **10**, p. 75, ☿.
Cremastogaster edentata Mayr, ibid., p. 104, ♀, pl. 2, fig. 10.
Cremastogaster deformis Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **5**, p. 467, ☿.
Crematogaster deformis Emery, Rev. Suisse zool., 1893, **1**, p. 193.

Type-locality: Singapore (A. R. Wallace).
Sarawak (Doria and Beccari; Bedot and Pictet); Kapouas Basin (Chaper).
A single worker from Kuching (John Hewitt).

*80a. CREMATOGASTER (PHYSOCREMA) DIFORMIS subsp. PHYSOTHORAX Emery.

Cremastogaster difformis st. *physothorax* Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 506, ☿.
Cremastogaster physothorax Dalla Torre, Cat. Hymenop., 1893, **7**, p. 84.

Type-locality: Thagatá, Tenasserim (L. Fea).
Four workers from Kuching (John Hewitt).

80b. CREMATOGASTER (PHYSOCREMA) DIFORMIS subsp. SEWARDI Forel.

Cremastogaster deformis subsp. *sewardi* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 64, ☿ ♀.

Type-locality: Borneo (Seward).

81. CREMATOGASTER (PHYSOCREMA) INFLATA Smith.

Crematogaster inflatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 76, ☿, pl. 2, fig. 2.
Cremastogaster inflata Mayr, Tijdschr. ent., 1867, **10**, p. 74, ☿; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 153; Emery, ibid., 1887, ser. 2, **5**, p. 466, ☿.

Type-locality: Singapore (A. R. Wallace).
Sarawak (Doria and Beccari).
Several workers from Kuching (John Hewitt; H. W. Smith) and one from the Rambungan River, Sarawak (H. W. Smith).

*82. CREMATOGASTER (PHYSOCREMA) STETHOGOMPHA, sp. nov.

Worker. Length 3–6 mm.

Head slightly broader than long, slightly broader behind than in front, with rounded, convex sides and broadly concave posterior border. Mandibles stout, rather convex, with oblique, coarsely 5-toothed apical borders. Clypeus moderately convex, ecarinate, with strongly depressed, straight, anterior border. Eyes small, flattened, just behind the middle of the head. Frontal carinae short, subparallel; frontal area small, triangular; frontal groove short and indistinct. Antennae 11-jointed; scapes reaching the posterior corners of the head; funiculi with 4-jointed club, all the joints longer than broad. Thorax resembling that of *C. deformis*, but the epinotum is less swollen above and is armed with two sharp, backwardly directed spines, which are longer than broad at their distinctly swollen bases. Promesonotal suture absent, pro- and mesonotum together, excluding the neck, as long as broad, robust, only slightly narrowed behind to the mesoëpinotal suture, which is distinct and transverse, but not impressed. The epinotum is broader than long, broader than the pro- and mesonotum, bulging on the sides and dorsally in front so that the base is very convex in profile. The declivity falls off vertically between the spines; it is as long as the base and longitudinally grooved in the middle. A more or less distinct carina or prominent ruga runs along the middorsal line of the thorax from the neck to the epinotal declivity, with an interruption at the mesoëpinotal suture. Petiole longer than broad, as broad in front as behind, octagonal, the anterior and posterior borders longer than the six other sides, which are subequal. In some specimens, especially in the small workers, the angles become rounded so that the petiole may be described as elongate elliptical. Its upper surface is flat; in profile it is slightly thicker at the posterior than at the anterior end. Postpetiole as broad as the petiole, contracted posteriorly, its anterodorsal surface flat, bilobed behind, but without a median longitudinal furrow in large specimens, feebly sulcate in small specimens. Gaster thick and broad, triangular, with straight anterior border, rounded anterior corners and pointed tip. Legs moderately long and stout.

Opaque; gaster and mandibles distinctly shining; the latter coarsely longitudinally striate and punctate. Clypeus and head densely punctate and reticulate-rugose, with more prominent longitudinal rugae anteriorly, growing finer and merging with the punctate surface on the occiput, sides, and posterior corners. Thorax densely punctate, the upper surface of the pro- and mesonotum and base of the epinotum also vermiculately rugose. Petiole, postpetiole, and first gastric segment much more finely and densely punctate than the thorax, the first segment also with sparser and somewhat larger, piligerous punctures; remaining gastric segments, legs, and scapes smoother, more shining, transversely alutaceous; the legs with sparse, coarse piligerous punctures.

Hairs short, whitish, delicate, sparse, and erect, of uneven length on the body, more numerous on the head and thorax than on the pedicel and gaster; shorter and more appressed on the legs and antennae. Pubescence pale, rather long, sparse, very distinct on the gaster and sides and posterior corners of the head.

Dark brown; mandibles, except the teeth, gula, and sometimes the lateral and posterior corners of the head, sides of epinotum, upper surface of petiole and articulations of legs, ferruginous red, second to fourth tarsal joints reddish yellow.

Numerous workers taken by Harrison W. Smith near Kuching (type-locality) and three workers from the Rambungan River, Sarawak. *Type.*— M. C. Z. 8,948.

This species is quite distinct from the other East Indian Physocremas, especially *deformis, inflata,* and *tumidula* Emery, and easily recognized by its large size, coarse sculpture, and well-developed epinotal spines. It is much more closely related to a form described by Forel from Malacca as *C. deformis* subsp. *vacca* (Bull. Soc. Vaud. sci. nat., 1911, ser. 5, **47**, p. 384) but which, I believe, should be regarded as an independent species. This Malaccan form, however, is black, measures only 3.3–3.5 mm., and has the epinotum much less swollen, and apparently even less distinctly constricted off from the mesonotum than in *stethogompha,* and the postpetiole is sulcate dorsally. It is, perhaps, admissible to regard *stethogompha* as a subspecies of *vacca.*

*82a. CREMATOGASTER (PHYSOCREMA) STETHOGOMPHA var. DETRITINODIS, var. nov.

Worker. Length 3.5 mm.

Differing from the typical form in having the head less distinctly concave behind and in sculpture, the rugae of the head and thorax being finer, so that the dense puncturation is more apparent and the vermiculate rugosity of the thorax is laxer and finer, especially in the middorsal region. The petiole and postpetiole are shining, the former elongate elliptical, the latter with a distinct median furrow. Mandibles more yellowish than in the typical form.

A single worker from the Sarawak River, Kuching (H. W. Smith).

83. CREMATOGASTER (OXYGYNE) DAISYI Forel.

Cremastogaster (*Oxygyne*) *daisyi* Forel, Ann. Soc. ent. Belgique, 1901, **45**, p. 376, ☿ ♀.

Type-locality: Sarawak (Haviland).

84. CREMATOGASTER (DECACREMA) DECAMERA Forel.

Cremastogaster (*Decacrema*) *decamera* Forel, Ann. Soc. ent. Belgique, 1910, **54**, p. 18 *nota,* ☿ ♀ ♂.

Type-locality: Sarawak (Haviland).

Five workers and a deälated female from Kuching (John Hewitt), "from Macaranga with slightly trifid leaves," and a winged female from British North Borneo (E. B. Kershaw).

85. CREMATOGASTER (DECACREMA) BORNEËNSIS Ern. André.

Cremastogaster borneënsis Ern. André, Rev. ent., 1896, p. 263, ☿.

Type-locality: Borneo.

85a. CREMATOGASTER (DECACREMA) BORNEËNSIS var. INSULSA Forel.

Cremastogaster (*Decacrema*) *borneënsis* var. *insulsa* Forel, Rev. Suisse zool., 1911, **19**, p. 33, ☿ ♀ ♂.

Type-locality: Borneo (Hose).

85b. CREMATOGASTER (DECACREMA) BORNEËNSIS var. HARPYIA Forel.

Cremastogaster (*Decacrema*) *borneënsis* var. *harpyia* Forel, Rev. Suisse zool., 1911, **19**, p. 33, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).

85c. CREMATOGASTER (DECACREMA) BORNEËNSIS subsp. SYMBIA Forel.

Cremastogaster (*Decacrema*) *borneënsis* subsp. *symbia* Forel, Rev. Suisse zool., 1911, **19**, p. 34, ☿ ♀ ♂.

Type-locality: Sarawak, Borneo (Haviland).

85d. CREMATOGASTER (DECACREMA) BORNEËNSIS subsp. NOVEM Forel.

Cremastogaster (*Decacrema*) *borneënsis* subsp. *novem* Forel, Rev. Suisse zool., 1911, **19**, p. 35, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).

I refer a single female from British North Borneo (E. B. Kershaw), to this subspecies.

85e. CREMATOGASTER (DECACREMA) BORNEËNSIS subsp. HOSEI Forel.

Cremastogaster (*Decacrema*) *borneënsis* subsp. *hosci* Forel, Rev. Suisse zool., 1911, **19**, p. 35, ☿.

Type-locality: Sarawak, Borneo (Haviland).

85f. CREMATOGASTER (DECACREMA) BORNEËNSIS subsp. CAPAX Forel.

Cremastogaster (*Decacrema*) *borneënsis* subsp. *capax* Forel, Rev. Suisse zool., 1911, **19**, p. 37, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).

86. CREMATOGASTER (DECACREMA) CAPTIOSA Forel.

Cremastogaster (*Decacrema*) *captiosa* Forel, Rev. Suisse zool., 1911, **19**, p. 37, ☿.

Type-locality: Sarawak, Borneo (Haviland).

87. CREMATOGASTER (DECACREMA) ANGULOSA Ern. André.

Cremastogaster angulosa Ern. André, Rev. ent., 1896, p. 264, ☿.

Type-locality: Borneo.

88. CREMATOGASTER (DECACREMA) BIFORMIS Ern. André.

Cremastogaster biformis Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 53, ☿.

Type-locality: Kapouas Basin, Borneo (Chaper).

89. VOLLENHOVIA PUNCTATOSTRIATA Mayr.

Vollenhovia punctatostriata Mayr, Reise Novara. Zool., **2**. Formicid., 1865, p. 21, *nota*, ♀; Mayr, Tijdschr. ent., 1867, **10**, p. 94, ♀; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 152, ♀; Emery, ibid., 1887, ser. 2, **5**, p. 453, ♀.

Type-locality: Java (Leyden Museum).
Sarawak (Doria and Beccari).

90. VOLLENHOVIA RUFIVENTRIS Forel.

Vollenhovia rufiventris Forel, Ann. Soc. ent. Belgique, 1901, **45**, p. 374, ☿.
Monomorium rufiventre Emery, in Sarasin and Roux, Nova Caledonia. Zool., 1914, **1**, p. 407 *nota*, ☿.

Type-locality: Sarawak, Borneo (Haviland).
Female. Length 11.5 mm.

Head rectangular, slightly longer than broad, nearly as broad in front as behind with feebly excised posterior border and a large shallow impression on each side of the vertex. Eyes small, near the middle of the sides, ocelli very small, the anterior distinctly larger than the posterior. Mandibles large, with nearly straight external borders, the apical borders broad, deeply and arcuately excised in the middle, with three large, subequal teeth at the apical and three smaller, blunt teeth at the basal end of the excision. Clypeus very short on the sides, rather flat in the middle, with a narrow elongation backward between the frontal carinae, the anterior border straight and entire. Frontal area obsolete; frontal carinae well-developed, nearly half as long as the antennal scapes, slightly diverging behind, nearly as far apart as their distance from the lateral border of the head. Antennae short, 12-jointed, the scapes strongly curved at the base, their tips reaching only to the posterior orbits; the funiculi with a 3-jointed club; joints 2–5 broader than long, joint 6 as long as broad, the remaining joints longer than broad. Thorax rather small, as broad as the head, the pronotum with submarginate sides and bluntly rectangular humeri, the mesonotum flattened above, as long as broad, prolonged in the middle anteriorly; the epinotum short, in profile evenly rounded and moderately convex, without distinct base and declivity, concave in the middle behind between a pair of slight swellings representing the denticles of other species. Petiole from above regularly rectangular, $1\frac{1}{2}$ times as long as broad, as broad in front as behind, with sharp anterior and posterior angles; in profile, with a node as high as the segment, its anterior surface concave, its posterior convex, the summit blunt and rounded; the lower surface anteriorly produced as a large protuberance translucent in the middle, and tipped with a small, blunt tooth. Postpetiole subrectangular, with convex sides and dorsum, slightly broader than long and broader than the petiole, its ventral surface with a large, thick, pointed, downwardly directed tooth at the anterior end. Gaster elongate elliptical, narrowed anteriorly and posteriorly. Legs with much thickened femora and clavate tibiae. Wings nearly 8 mm. long, narrow, with a single cubital and a small, narrow discoidal cell; radial cell open; pterostigma small but distinct.

Very shining; mandibles sparsely punctate, sharply longitudinally striate along the external borders and at the tip. Clypeus uneven but not rugose. Cheeks and anterior $\frac{3}{4}$ of head above, longitudinally and rather densely rugose, with interspersed punctures; occipital region and sides of gula with coarse, piligerous punctures. Pronotum coarsely and sparsely punctate, indistinctly striate on the sides. Mesonotum finely, longitudinally rugose behind, anteriorly smooth in the middle and coarsely and sparsely punctate on the sides. Scutellum and sides of epinotum sharply, longitudinally rugose, the former smooth and more or less coarsely punctate in the middle. Slope of epinotum, petiole, postpetiole, gaster, scapes, and legs very smooth and shining, with sparse piligerous punctures; lateral and ventral portions of petiole and postpetiole densely and finely punctate.

Hairs slender, pointed, whitish, sparse, of very unequal length, suberect or erect, shorter and more reclinate on the appendages, partly short and appressed on the gaster.

Black; terminal antennal joint, articulations of legs and tarsi, beyond the basal joint, reddish brown; cheeks and tips of mandibles obscurely tinged with red. Wings distinctly infuscated, more deeply along the anterior margin; veins and pterostigma dark brown.

Described from a single specimen taken on Mt. Matang, West Sarawak by G. E. Bryant and sent me by Mr. Horace Donisthorpe. There is also a worker from Kuching (John Hewitt) in my collection.

I have described the female in detail on account of its interest in connection with Emery's contention (in Sarasin and Roux, Nova Caledonia. Zool., 1914, **1**, p. 407 *nota*) that *rufiventris* is really a Monomorium, mainly because the worker is smooth and shining and has a slightly pedunculate petiole. Although my specimen is not accompanied by workers, Forel's recent discovery (Tijdschr. ent., 1915, **58**, p. 23) of all three phases of a new variety of this ant, var. *simalurana* from Simalur, a small island off the west coast of Sumatra, shows that the Bornean female must belong to the typical *rufiventris* or one of its varieties. The worker *simalurana* varies from 3–7.9 mm. in length, the female measures 12–12.5 mm. and the male only 4.4 mm. These extraordinary differences in stature are comparable to those previously noted by Forel (Philippine journ. sci., 1910, **5**, p. 125) in *V. oblonga* subsp. *dispar*, the worker of which measures 3.2 mm., the female 8 mm., the male 3.8 mm. Certainly the female of what I take to be the typical *rufiventris* described above and that of the var. *simalurana*, which is merely somewhat larger and very slightly different in other respects, must be regarded as belonging to Vollenhovia. It is, moreover, closely related to *V. striatopunctata* Mayr, known only from the female (9–10 mm. long), and considered by Emery as probably the female of *V. oblonga* subsp. *laevithorax* Emery (*loc. cit.*, p. 406). In some species and subspecies of Vollenhovia, however, the female is only slightly larger than the worker, *e.g.*, in *V. emeryi* Wheeler of Japan and in a Bornean subspecies of *V. banksi* Forel described below.

91a. Vollenhovia oblonga Smith var. rufescens Emery.

Vollenhovia rufescens Emery, Bull. Soc. ent. France, 1894, p. 69, ☿.

Vollenhovia oblonga var. *rufescens* Emery, in Sarasin and Roux, Nova Caledonia. Zool., 1914, **1**, p. 406, ☿.

Type-locality: Pulo Laut, Borneo.

Borneo (Coll. Emery).

91b. VOLLENHOVIA OBLONGA subsp. ALLUAUDI Emery.

Vollenhovia alluaudi Emery, Bull. Soc. ent. France, 1894, p. 68, ☿.
Vollenhovia oblonga var. *alluaudi* Emery, Ann. Mus. civ. Genova, 1897, ser. 2, **18,** p. 560, ☿.
Vollenhovia oblonga subsp. *alluaudi* Emery, in Sarasin and Roux, Nova Caledonia. Zool., 1914, **1**, p. 406; Forel, Trans. Linn. soc. London. Zool., 1912, ser. 2, **15**, p. 162, ☿ ♀.

Type-locality: Seychelles.
Borneo (Coll. Emery).

91c. VOLLENHOVIA OBLONGA subsp. LAEVITHORAX Emery.

Vollenhovia laevithorax Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 501, ☿.
Vollenhovia oblonga subsp. *laevithorax* Emery, in Sarasin and Roux, Nova Caledonia. Zool., 1914, **1**, p. 406.

Type-locality: Tenasserim (L. Fea).
Borneo (Coll. Emery).

*92. VOLLENHOVIA HEWITTI, sp. nov.

Worker. Length 2.4–2.6 mm.

Head rectangular, about $\frac{1}{5}$ longer than broad, with parallel sides and nearly straight posterior border. Eyes flattened, a little in front of the middle of the sides. Mandibles rather broad, their apical and basal borders meeting at a sharp right angle, the former with three large apical and a few minute and indistinct basal teeth. Clypeus rather convex in the middle, strongly bicarinate, its anterior border straight and entire. Frontal area small, semicircular, frontal carinae short. Antennal scapes reaching nearly to the posterior third of the head; funiculi with a 4-jointed club, joints 2–7 decidedly broader than long. Thorax rather long, narrower than the head, the pro- and mesonotum together longer than broad, with prominent humeri, somewhat flattened dorsally and laterally; mesoëpinotal constriction narrow but distinct. Epinotum from above a little longer than broad, distinctly narrower than the mesonotum, laterally compressed above in profile, with the base feebly rounded, and longer than the abrupt, concave declivity, which is slightly angulate but not dentate on each side above. Petiole narrow, twice as long as broad, as broad in front as behind, through the node nearly as high as long, the latter blunt and rounded, with subequal, slightly concave anterior and feebly convex posterior slope, the ventral surface anteriorly with a compressed, translucent tooth. Postpetiole broader than the petiole, longer than broad, scarcely broader behind than in front, elliptical, with convex lateral and dorsal surfaces.

Shining; mandibles with a few minute, scattered punctures; head with the cheeks and anterior $\frac{4}{5}$ above subopaque, longitudinally rugulose and sparsely serially punctate; occiput and lower surface coarsely and sparsely punctate and shining. Thorax above smooth, with small, scattered, piligerous punctures; sides of thorax subopaque and densely punctate; extreme base of first gastric segment sharply striate; remainder of body smooth and shining, with indistinct, scattered, piligerous punctures.

Hairs pale, sparse, of unequal length, erect or reclinate; on the appendages shorter and more appressed.

Dark castaneous brown; mandibles, tips of scapes, funiculi, trochanters, knees, tibiae and tarsi red.

Described from four specimens taken at Kuching (John Hewitt).

This species resembles *V. oblonga* subsp. *laevithorax* Emery in sculpture, but is much smaller, with narrower head, broader mandibles and longer petiole and postpetiole, and is quite different from any of the numerous other species of Vollenhovia recently described by Emery, Forel, and Viehmeyer. The genus is difficult, so that the limits of the subspecies and varieties are still to be established on the basis of much more material than has been collected heretofore.

*93a. VOLLENHOVIA BANKSI Forel subsp. KUCHINGENSIS, subsp. nov.

Worker. Length 1.8–2 mm.

Differing from the typical form from the Philippines in its darker color, the body, femora, and tibiae being dark brown. The meso-ëpinotal impression is visible, though very feeble; the epinotum has a minute denticle on each side, the antennal scapes are a little shorter and the eyes a little further forward on the head.

Female (deälated). Length nearly 3 mm.

Resembling the worker, but the rugae on the head are coarser, more undulating, with finely punctate interrugal spaces. The thorax above is coarsely and rather densely punctate, the pronotum somewhat reticulately rugose, the mesonotum smooth in the middle in front, longitudinally rugulose behind, the mesopleurae rather smooth and shining in the middle. The epinotum is coarsely reticulately rugose, the concavity of the declivity transversely rugose; the petiole and postpetiole above coarsely foveolate. The tips of the antennal scapes reach only a little beyond the median transverse diameter of the head.

Described from twelve workers and a single female from Kuching (John Hewitt) taken "from an old fungus." I have compared the workers with a couple of cotypes of *banksi* received from the Manila Bureau of Science. *Type.*—M. C. Z. 8,949.

94. MONOMORIUM FLORICOLA (Jerdon).

Atta floricola Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 107; Jerdon, Ann. mag. nat. hist., 1854, ser. 2, **13**, p. 49, ☿.

Monomorium speculare Mayr, Sitzb. Akad. wiss. Wien, 1866, **53**, p. 509, ☿.

Monomorium floricola Emery, in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 66.

Type-locality: Tellicherry, Southern India (Jerdon).
Sarawak (Doria and Beccari).
Several workers from Kuching (John Hewitt).

95. MONOMORIUM LATINODE Mayr.

Monomorium latinode Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 152, ☿; Emery, ibid., 1887, ser. 2, **5**, p. 459, ☿.

Type-locality: Sarawak (Doria and Beccari).

96. MONOMORIUM PHARAONIS (Linné).

For the long synonymy of this cosmopolitan ant see Dalla Torre, Cat. Hymenop., 1893, **7**, p. 68.

Type-locality: Egypt.
Sarawak (Doria and Beccari).
Numerous workers and deälated females from Kuching, Matang, and Poi (John Hewitt).

*97. SOLENOPSIS GEMINATA (Fabricius) subsp. RUFA (Jerdon).

Atta rufa Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 106; Jerdon, Ann. mag. nat. hist., 1854, ser. 2, **13**, p. 48, ♃ ☿ ♀.

Solenopsis geminata Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 996 (part); Mayr, ibid., 1886, **36**, p. 460 (part); Rothney, Trans. Ent. soc. London, 1889, p. 365.

Solenopsis geminata var. *rufa* Forel, Deutsch. ent. zeitschr., 1909, p. 268.

Solenopsis geminata race *rufa* Forel, Biol. Centr. Amer. Hymenop., 1899–1900, **3**, p. 80.

Type-locality: Malabar, Southern India (Jerdon).

Two workers and a male from Kuching (John Hewitt).

98. LOPHOMYRMEX BEDOTI Emery.

Lophomyrmex bedoti Emery, Rev. Suisse zool., 1893, **1**, p. 192, ☿ ♀.

Type-locality: Deli, Sumatra (Bedot and Pictet).

Pulo Laut, Borneo (Coll. Emery).

A single worker from Kuching (John Hewitt).

99. PHEIDOLOGETON AFFINIS (Jerdon).

Oecodoma affinis Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 110, ♃ ☿; Jerdon, Ann. mag. nat. hist., 1854, ser. 2, **13**, p. 51, ♃ ☿.

Pheidole affinis Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 174, ☿.

Atta bellicosa Smith, ibid., p. 164, ☿.

Solenopsis laboriosa Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **6**, p. 48, ☿.

Pheidologeton laboriosus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 750, ☿.

Pheidologeton affinis Roger, Verzeich. formicid., 1863, p. 30.

Solenopsis calida Smith, Journ. Proc. Linn. soc. London. Zool., 1863, **7**, p. 22, ☿.

Pheidologeton bellicosum Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 360.

Type-locality: Malabar, Southern India (Jerdon).

Kapouas Basin, Borneo (Chaper).

A single worker media from Sarawak (Roland Thaxter).

100. PHEIDOLOGETON DIVERSUS (Jerdon).

Oecodoma diversus Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 109, ☿; Jerdon, Ann. mag. nat. hist., 1854, ser. 2, **13**, p. 51, ☿.

Pheidole diversa Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 174, ☿.

Pheidole ocellifera Smith, ibid., p. 174, ♃.

Pheidole pabulator Smith, Journ. Proc. Linn. soc. London. Zool. 1861, **5**, p. 112, ☿.

Pheidologeton ocelliferus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12,** p. 750 ♃, pl. 19, fig. 13.
Pheidologeton megacephalus Roger, Verzeich. formicid., 1863, p. 30 ♃.
Pheidologeton diversus Roger, ibid., p. 30.
Pheidologeton ocellifer Mayr, Reise Novara. Zool., **2.** Formicid., 1865, p. 103.
Pheidologeton pabulator Mayr, Verh. Zool. bot. gesellsch. Wien., 1886, **36.** p. 362.
Pheidole megacephalotes Dalla Torre, Wien. ent. zeit., 1892, **11,** p. 90.

Type-locality: Wynaad, Southern India (Jerdon).
Kapouas Basin, Borneo (Chaper).

101. Dilobocondyla borneënsis Wheeler.

Dilobocondyla borneënsis Wheeler, Proc. New Engl. zool. club, 1916, **6,** p. 12, ☿, fig. 2.

Type-locality: Bongo Mt., Sarawak, Borneo (John Hewitt).

102. Pristomyrmex trachylissus (Smith).

Myrmica (Monomorium) *trachylissa* Smith, Cat. Hymenop. Brit. mus., 1858, **6,** p. 126, ♀.
Pristomyrmex trachylissa Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36,** p. 359.
Pristomyrmex trachylissus Dalla Torre, Cat. Hymenop., 1893, **7,** p. 62.

Type-locality: Borneo (A. R. Wallace).

103. Myrmecina undulata Emery.

Myrmecina undulata Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20,** p. 678, ☿ ♀.

Type-locality: Si Rambé, Sumatra (E. Modigliani).
Pulo Laut, Borneo (Coll. Emery).

*104. Acanthomyrmex dyak, sp. nov.

Soldier. Length 5 mm.

Head very large, convex above, overlapping the thorax nearly to the mesoëpinotal constriction, subrectangular, a little longer than broad, with rather straight, subparallel sides, bilobed behind, owing to the deep, angular occipital incision, which is continued into a deep occipital and frontal groove all the way to the frontal area. Eyes small, moderately convex, elongate elliptical at the anterior third of the head. Mandibles very large and convex, with very broad, straight, edentate apical and very concave basal borders. Clypeus depressed on the sides and behind, convex and roof-like, but not carinate in the middle in front, where it projects over the proximal ends of the apical mandibular borders as a short lobe, with straight margin and indistinctly dentate corners. Frontal area rather distinct, triangular. Frontal carinae strongly diverging behind, each bordering a deep narrow scrobe for the antennal scape, running down obliquely to the side of the head a little behind and above the eye. At this point it turns sharply at an angle to form a short scrobe for the base of the funiculus, running forward just above the eye and merging anteriorly into an interrugal space. Antennae slender, the scapes curved and flattened but not dilated at the base. Funiculi with a 3-jointed club, shorter than the remainder of the funiculus; joints 2–8 as long as broad. Thorax short, less than half as broad as the head; pro- and mesonotum rather depressed dorsally where they are covered by the posterior portion of the head; pronotum without spines. Mesoëpinotal constriction not very pronounced. Epinotum very short, its base much shorter than the vertical declivity; the spines very long, slightly curved downward, thick at the base, strongly tapering at the tips, diverging outward, backward and upward, much longer than their distance apart at the base. Metasternal angles small, acute, directed upward. Petiole from above nearly twice as long as broad, a little broader behind than in front, with concave sides and narrow node, armed with two upwardly directed acute spines, the space between which is semicircular; anterior surface of the node long and concave, the posterior straight and abrupt. Postpetiole a little broader than the petiole and a little broader than long, very convex dorsally and rounded on the sides. Gaster only about $\frac{1}{4}$ as large as the head, subcircular, flattened, with straight anterior border. Femora thickened in the middle, tibiae somewhat clavate.

Rather shining; mandibles smooth, with very fine, widely scattered punctures. Clypeus smooth and shining. Head covered with umbilicate piligerous foveolae, elongate on the gular surface, on the space between the frontal carinae interspersed with strong, diverging longitudinal rugae; cheeks coarsely, longitudinally rugose, space enclosed by the two limbs of the scrobes coarsely reticulate-rugose; the scrobes smooth and shining, not transversely rugose. Thorax coarsely and reticulately rugose; epinotal declivity between the spines and the whole petiole smooth and shining; postpetiole coarsely and indistinctly rugose above, subopaque. Gaster smooth and shining.

Hairs pale grayish, short, erect, blunt, but not thick, sparse, covering the scapes and legs including the funiculi and tarsi as well as the body, more abundant on the gaster; on the antennal scapes, most numerous on the anterior surface; on the legs, most numerous on the extensor surfaces.

Deep ferruginous brown; mandibles, antennae, legs, epinotal spines, and peduncle of petiole deep red; gaster and borders of mandibles blackish.

Worker. Length 3.5 mm.

Head much smaller than in the soldier, as broad as long, rather rectangular, with straight posterior border and feebly convex sides. Eyes small, but very convex, hemispherical, distinctly behind the middle of the head. Mandibles large, shaped somewhat as in the soldier, but with much less convex external borders, with 2 or 3 apical and several minute, widely spaced basal teeth. Clypeus moderately convex, with nearly straight anterior border. Frontal area large, flat, triangular. Antennal scrobes short, limited to a groove for the base of the scapes between the prominent rugae. Antennal scapes straight, not flattened at the base, extending about $\frac{1}{3}$ their length beyond the posterior corners of the head. Funiculi also longer than in the soldier, with all the joints longer than broad. Thorax shaped much as in the soldier, but the pronotum with a pair of very long, straight, pointed spines, directed upward and outward, distinctly longer than the similarly directed spines on the epinotum. The latter, however, are bent slightly backwards at a feeble angle just beyond the middle. Shape of petiole, postpetiole, and gaster much as in the soldier, but the spines on the petiole are less spreading and more erect, more slender, and acute.

Sculpture of thorax like that of the soldier; mandibles and clypeus smooth, the anterior border of the latter with short, coarse rugae, the head very coarsely longitudinally rugose, the rugae connected by transverse rugules. Antennal scrobes shining, feebly punctate, transversely rugulose anteriorly. Petiole postpetiole and gaster smooth and shining.

Pilosity and color much like those of the soldier, except that the mandibles are more yellowish and without dark borders.

Described from a single soldier and two workers taken by Mr. John Hewitt at Kuching.

This species seems to be very close to *A. ferox* Emery, based on a worker specimen from Perak. I am, however, unable to make Emery's description of the sculpture of the head and thorax accord with that of the Bornean form. At any rate his words "foveolis piligeris confertis sculptum" do not seem to me to describe the conditions in my specimens. Moreover, he gives the length of his specimen as about 4.5 mm. and describes the two pairs of thoracic spines as equal ("thorax spinis quatuor subrectis, aequalibus armatus"), and the postpetiole as "sublaevis," whereas it is very smooth and shining in *dyak*. The ants of the genus *Acanthomyrmex* seem to be very rare. No one has taken *A. notabilis* since it was described by Smith, and Bingham in the Fauna of British India merely translates Emery's description of *A. luciolae* of Ceylon. Emery has recently based another species, *A. kochi,* from New Guinea (Nova Guinea, **9**, Zool., 1911, **2**, p. 252) on a single worker specimen. It is very small (2.2 mm.), ferruginous yellow, with the spines more curved and more nearly horizontal than in the other species.

*105. ACANTHOMYRMEX DUSUN, sp. nov.

Soldier. Length 3.6 mm.

Head very large, extending back over the thorax to the mesoëpinotal constriction, subrectangular, a little longer than broad, with straight, parallel sides in front and rounded posterior corners, or lobes, separated by an angular occipital incision continuous with a deep occipital and frontal groove, running forward to the clypeus. In profile the dorsal surface of the head is convex and rounded, but distinctly depressed in the middle just in front of the occipital border. Eyes small, elongate elliptical, rather convex, at the anterior fourth of the sides. Clypeus, mandibles, and antennal scrobes shaped much as in *dyak*, but the frontal carinae which border them much more diverging behind and the frontal area obsolete. Antennae also very similar, but joints 2 and 3 more transverse and joints 4–8 as long as broad. Thorax short, the epinotal spines very long, stout at the base, tapering and pointed at the tips, strongly curved backward and downward and somewhat outward. Petiole fully twice as long as broad, its anteroposteriorly compressed node narrowed above, without spines, but with its rather sharp, transverse margin angularly excised. Postpetiole regularly rectangular, broader than long, broader than the petiole, rather flat above. Gaster about $\frac{1}{4}$ as large as the head, excluding the mandibles, nearly circular, with rather straight anterior border. Femora thickened in the middle, tibiae clavate.

Shining; mandibles and clypeus smooth, the former sparsely and finely punctate, the latter without rugosities along its anterior border. Head covered rather uniformly with sparse, punctate foveolae, the triangular space between the two limbs of each scrobe very coarsely reticulate-rugose, the space between the frontal carinae finely, but not uniformly, longitudinally striate, the scrobes transversely striolate. Thorax and postpetiole very coarsely reticulate-rugose, epinotal declivity between the spines, the petiole and gaster very smooth and shining.

Pilosity much as in *dyak*, but the hairs longer and more delicate, though blunt, and somewhat more numerous on the head, forming an even row along the anterior border of the antennal scapes and more numerous on the extensor than on the flexor surfaces of the legs.

Brownish ferruginous; mandibles, antennae, and legs deep red; petiolar node, postpetiole, and gaster black.

Described from a single specimen taken on Mt. Matang, West Sarawak by Mr. G. E. Bryant and sent me by Mr. Horace Donisthorpe.

This species is certainly very different from *dyak* and *luciolae,* but seems to be closely related to Smith's *notabilis* described from the island of Batjan. Judging from Smith's figure and description, however, *dusun* has a smaller and longer head and more curved epinotal spines. My specimen seems to be too small to be the soldier of Emery's *ferox.*

106. CALYPTOMYRMEX EMERYI Forel.

Calyptomyrmex emeryi Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 51, ☿ ♂.

Type-locality: Sarawak, Borneo (Haviland).
Female. Length 4.5 mm.

Very similar to the worker. Thorax narrower than the head only slightly longer than broad; mesonotum somewhat flattened above, subtriangular, fully as broad as long; scutellum longitudinally impressed in the middle, overhanging the extremely short, vertical epinotum. Both the mesonotum and scutellum coarsely reticulate-rugose. Wings with well-developed discoidal cell, large pterostigma and single cubital cell, the membranes uniformly brownish hyaline, the veins and pterostigma darker brown.

A single specimen from Kuching (John Hewitt), which has been compared with a worker cotype in my collection.

107. MERANOPLUS CASTANEUS Smith.

Meranoplus castaneus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 81, ♀, pl. 2, fig. 7; Forel, Zool. jahrb. Suppl., 1912, **15**, p. 61.
Meranoplus cordatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 82, ☿, pl. 2, fig. 5; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 155, ☿; Emery, ibid., 1887, ser. 2, **5**, p. 470, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Doria and Beccari).

108. MERANOPLUS MUCRONATUS Smith.

Meranoplus mucronatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 82, ☿, pl. 2, fig. 6; Mayr, Tijdschr. ent., 1867, **10**, p. 84, ☿.

Type-locality: Mt. Ophir, Malacca (A. R. Wallace).
Borneo.

*109. TETRAMORIUM CURTULUM Emery.

Tetramorium curtulum Emery, Ann. Mus. civ. Genova, 1894, ser. 2, **14**, p. 22, ☿.

Type-locality: Palon, Burmah (L. Fea).

A single worker from Mt. Matang, West Sarawak (G. E. Bryant), received from Mr. Donisthorpe.

*110. TETRAMORIUM SIMILLIMUM (Smith).

Myrmica simillima (Nylander) Smith, List. Brit. anim. Brit. mus., 1851, **6**, Acul. p. 118, ☿.

Tetrogmus caldarius Roger, Berl. ent. zeitschr., 1857, **1**, p. 12, ☿ ♀.

Myrmica (Leptothorax) simillima Smith, Cat. Brit. foss. Hymenop., 1858, p. 31, ☿.

Myrmica caldaria Meinert, Naturv. afh. Dansk. vid. selsk., 1860, ser. 5, **5**, p. 334, ☿ ♀ ♂.

Tetramorium simillimum Mayr, Europ. Formicid., 1861, p. 61, ♀.

Type-locality: Dorsetshire, England, in a hot-house (Dale).

Four workers from Sarawak (Roland Thaxter).

111. TETRAMORIUM PACIFICUM Mayr.

Tetramorium pacificum Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 972, 976, ☿ ♀.

Type-locality: Tongatabu, Friendly Islands (Museum Godeffroy).

Kapouas Basin, Borneo (Chaper); Tandjong (Fritz Suck).

112. TETRAMORIUM SCABRUM Mayr.

Tetramorium scabrum Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 672, ☿.

Type-locality: Borneo (Museum of Pest).

A single worker from Bongo Mt., Sarawak (Hewitt and Brooks).

113. TETRAMORIUM GUINEENSE (Fabricius).

For the synonymy of this common tropicopolitan ant see Dalla Torre, Cat. Hymenop. 1893, **7**, p. 133.

Type-locality: Guinea (Dr. Isert).

Sarawak (Doria and Beccari; Bedot and Pictet); Kapouas Basin (Chaper).

Several workers and a female from Kuching (John Hewitt).

114. TRIGLYPHOTHRIX PARVISPINA Emery.

Triglyphothrix parvispina Emery, Rev. Suisse zool., 1893, **1**, p. 214, ☿.

Type-locality: Pulo Laut, Borneo.

*115. TRIGLYPHOTHRIX STRIATIDENS (Emery).

Tetramorium obesum st. striatidens Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 501, ☿.

Triglyphothrix obesus st. striatidens Emery, Explor. sci. Tunisie. Fourmis, 1891, p. 4.

Triglyphothrix striatidens Dalla Torre, Cat. Hymenop., 1893, **7**, p. 136.

Type-locality: Bhamô, Burmah (L. Fea).

A worker and female from Kuching (John Hewitt) and a worker from Sarawak (Roland Thaxter).

116. CATAULACUS BROOKEI Forel.

Cataulacus brookei Forel, Ann. Soc. ent. Belgique, 1901, **45**, p. 378, ☿ ♀ ♂.

Type-locality: Sarawak, Borneo (Haviland).

117. CATAULACUS GRANULATUS (Latreille).

Formica granulata Latreille, Hist. nat. fourmis, 1802, p. 275, ☿, pl. 12, fig. 75.

Cryptocerus granulatus Lepeletier, Hist. nat. ins. hyménop. 1836, **1**, p. 171.

Cataulacus granulatus Smith, Trans. Ent. soc. London, 1854, ser. 2, **2**, p. 226.

Cataulacus reticulatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 81, ☿, pl. 2, fig. 8.

Type-locality: "Grandes-Indes."

Sarawak, Borneo (A. R. Wallace).

117a. CATAULACUS GRANULATUS subsp. HISPIDUS Smith.

Cataulacus hispidus Smith, Trans. Ent. soc. London, 1876, p. 611, ☿, pl. 11, fig. 11.
Cataulacus granulatus subsp. *hispidus* Forel, Rev. Suisse zool., 1911, **19**, p. 24, ☿.

Type-locality: Singapore.
Sarawak, Borneo (Haviland).
A single worker from Kuching (John Hewitt).

118. CATAULACUS HISPIDULUS Smith.

Cataulacus hispidulus Smith, Journ. Proc. Linn. soc. London. Zool., 1864, **8**, p. 76, ☿, pl. 4, fig. 7; Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 155; Emery, ibid., 1887, ser. 2, **5**, p. 470, ☿; Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 55, ☿.
Cataulacus granulatus var. *hispidulus* Dalla Torre, Cat. Hymenop., 1893, **7**, p. 138.

Type-locality: Sumatra (A. R. Wallace).
Sarawak (Doria and Beccari), Kapouas Basin (Chaper).
Four workers from Kuching (John Hewitt) and one from Bongo Mt. (Hewitt and Brooks).

119. CATAULACUS HORRIDUS Smith.

Cataulacus horridus Smith, Journ. Proc. Linn. Soc. London. Zool., 1857, **2**, p. 81, ☿, pl. 2, fig. 3; Emery, Rev. Suisse zool., 1893, **1**, p. 216.
Cataulacus insularis Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 80, ♂, pl. 2, fig. 4.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Three workers and six males from Kuching (John Hewitt). The males agree very closely with Smith's description of his *C. insularis*, except in having the gaster entirely black, so that I regard *insularis* as a synonym of *horridus*. He describes the gaster of his specimen as reddish at the base, a condition probably due to immaturity.

120. CATAULACUS PRAETEXTUS Smith.

Cataulacus praetextus Smith, Trans. Ent. soc. London, 1867, ser. 3, **5**, p. 528, ☿, pl. 26, fig. 5.

Type-locality: Borneo.

I refer a female specimen from Kuching (John Hewitt) to this species.

*121. CATAULACUS LATISSIMUS Emery.

Cataulacus latissimus Emery, Rev. Suisse zool., 1893, **1**, p. 215, ☿, pl. 8, fig. 10.

Type-locality: Perak (Bedot and Pictet).

Two workers from Kuching (John Hewitt).

*122. STRUMIGENYS INDAGATRIX, sp. nov.

Worker. Length 1.7 mm.

Slender; head flattened, 1¾ times as long as broad, with semicircularly excised posterior border, narrowed at the eyes, the portion anterior to the antennal insertions as long as broad; eyes moderately large and convex. Mandibles about half as long as the head, straight, slender, slightly narrowed at their insertions, with straight, parallel borders, a pair of long, acute, subequal apical teeth and a spiniform preapical tooth of the same shape but somewhat shorter. Clypeus as long as broad, flat, with entire anterior border. Antennae slender; the scapes reaching nearly to the posterior fifth of the head; last funicular joint longer than the remainder of the funiculus; joints 2 and 3 subequal, small, not longer than broad, fourth joint a little longer than the first, about twice as long as the second and third together. Thorax narrow, the profile outline of the pronotum feebly convex, rising to the mesonotum, which is the highest part of the thorax, and descending gradually to the long epinotum, the base of which is nearly straight in profile and fully 1⅔ times as long as the declivity. The spines are rather long and slender, but indistinct, as each is embedded in a spongiform plate continued down the side of the declivity. Petiole and postpetiole with large spongiform masses on the sides and ventrally, so that only the dorsal surfaces are exposed. Gaster but little broader than its straight, transverse, anterior border. Legs slender.

Mandibles, gaster, and dorsal surface of postpetiole smooth and shining; head, thorax, petiole, legs, and antennae opaque, densely and regularly punctate, the head a little more coarsely than the thoracic dorsum, the appendages very finely. Extreme base of gaster longitudinally rugose.

Hairs yellowish, sparse, rather long, especially at the tip of the gaster, erect or suberect, shorter and blunter on the head, on the clypeus and anterior border of the scape curved but pointed, nonclavate. Legs with very short, subappressed hairs.

Yellowish ferruginous; mandibles and legs paler.

Described from two specimens taken by Mr. John Hewitt at Kuching.

In the shape of the head, mandibles, and antennae this species approaches *S. mocsaryi* Emery of Papuasia, but the mandibles are decidedly shorter and the pilosity and arrangement of the spongiform appendages of the petiole are very different. The Bornean species is also related to four Javanese species recently described by Forel (*S. kraepelini, koningsbergi, signeae, and ebbae*), but is smaller than any of them. It can be readily distinguished from *kraepelini* and *koningsbergi* by the well-developed, spiniform, preapical tooth of the mandibles. *S. signeae* possesses a translucent inner border to the mandibles and an emarginate clypeus and in *ebbae* the preapical tooth is only slightly longer than broad, the antennal scapes are shorter, the first funicular joint not longer than broad, the hairs are club-shaped and the color is deep ferruginous.

*123. STRUMIGENYS BRYANTI, sp. nov.

Female. Length, 4.8 mm.

Slender; head fully 1¾ times as long as broad, its posterior border deeply and semicircularly excised, the sides gradually converging to the rather large, convex eyes, the preocular portion 1½ times as long as broad, with subparallel sides; vertex very feebly convex, the posterior lobes depressed and flattened. Mandibles fully ½ as long as the head, straight, flattened, with parallel borders, very slightly narrowed at their insertions, sinuately excised at the inner border just back of the two strong, subequal, spiniform, apical teeth. Preapical tooth absent. Clypeus flattened, as long as broad, its anterior border entire. Antennae very slender; scapes reaching to the posterior fourth of the head; last funicular joint much shorter than the remainder of the funiculus and somewhat longer than the preceding joint, joints 2 and 3 subequal, as long as broad, together a little more than half as long as the first joint. Thorax distinctly narrower than the head, a little more than twice as long as broad, very high and convex in the region of the mesonotum and scutellum, the epinotum low with short horizontal base and long vertical declivity, meeting it at a right angle; spines reduced to rectangular flat teeth, each continued as a translucent, spongiform plate down the side of the declivity. Petiole three times as long as broad, broader behind than in front, with straight sides, the node low and rounded, in profile gradually passing into the peduncle, its posterior border with spongiform appendages and its ventral surface behind with a median spongiform lamella. Postpetiole subcircular, as long as broad, broader than the petiolar node, only its dorsal surface exposed, the remainder embedded in spongiform material, with a long, flat plate of the same substance depending from its midventral line. Gaster small, narrow and straight in front, its anteroventral surface with a broad mass of spongiform material. Legs long and slender. Wings with small pterostigma and almost no veins.

Opaque; mandibles and gaster shining; the gaster longitudinally rugose and reticulate at the base. Remainder of body densely and finely punctate, rugulose, the posterior lobes of the head regularly and more coarsely, the appendages more finely punctate.

Hairs pale yellow; very long, sparse, erect, slender, and pointed, quite as long and conspicuous on the legs as on the body; antennal scapes with short curved, subappressed, pointed hairs, not arranged in a regular row. Head, clypeus, and thorax also with numerous short, appressed, simple hairs, representing a long, dilute pubescence.

Ferruginous brown; mandibles, antennae, legs, and base and tip of gaster paler and more yellowish. Wings yellowish hyaline with dark brown pterostigma.

Described from a single specimen taken by Mr. G. E. Bryant on Mt. Matang, West Sarawak and sent me by Mr. Horace Donisthorpe.

In size, in the general shape of the body and its extraordinary pilosity, this species is most closely related to *S. doriae* Emery, described from a worker specimen taken in Amboina. This form, however, has more slender and cylindrical mandibles, so that the Bornean specimen can hardly be the cospecific female.

*124. RHOPALOTHRIX BORNEËNSIS, sp. nov.

Female (deälated). Length, 3.5 mm.

Resembling *Rh. procera* Emery, but smaller and the emarginations of the sides of the head at the eyes and antennal insertions deeper and more sinuous and the border just behind the eyes forming a rounded, rather flattened lobe. The clypeus is distinctly longer, its median portion being prolonged further posteriorly. Thorax decidedly narrower than the head, the pronotum laterally compressed, deeply and angularly excised behind. Mesonotum flattened above, grooved in the middle, but not carinate anteriorly. Scutellum and epinotum very small, the former gibbous, overhanging the latter, which has a pair of acute, flattened teeth as long as broad at their bases. Petiolar node subrectangular when seen from above, as long as broad; feebly longitudinally impressed in the middle. Postpetiole $2\frac{1}{2}$ times as broad as the petiole, much broader than long, with broadly concave anterior and broadly convex posterior border, the dorsal surface with a feeble median sulcus in front and a large round impression behind. Gaster with a faint median sulcus.

Opaque; densely and finely punctate-rugulose; gaster and postpetiole evenly punctate; antennal scrobes and mesopleurae shining.

Head, legs, and dorsal surface of body covered with dirty white, flattened, appressed, scale-like hairs, fine and numerous on the clypeus and mandibles, long and conspicuous on the external borders of the antennal scapes, tibiae, and tarsi, absent on the pleurae and lateral surfaces of the coxae.

Ferruginous brown; appendages scarcely paler.

Described from a single specimen taken by Mr. John Hewitt at Kuching in 1908 "in an old fungus."

Additional material may show that this is merely a small subspecies of *Rh. procera* Emery of New Guinea. The female of this form measures 5 mm. and has the petiolar node broader than long. *Rh. borneënsis* seems also to be more opaque than *procera,* but Emery's description of the female is very brief.

DOLICHODERINAE.

125. DOLICHODERUS (HYPOCLINEA) BITUBERCULATUS (Mayr).

Hypoclinea bituberculata Mayr, Verh. Zool. bot. gesellsch. Wien., 1862, **12**, p. 705, ☿.

Dolichoderus bituberculatus Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 254, ☿ ♀.

Hypoclinea sellaris Roger, Berl. ent. zeitschr., 1863, **7**, p. 168, 213, ☿.

Dolichoderus (*Hypoclinea*) *bituberculatus* Emery, Gen. Ins. Dolichod., 1912, p. 10.

Type-locality: Luzon Island, Philippines.

Sarawak (Doria and Beccari; Bedot and Pictet); Kapouas Basin (Chaper); Bandjermassin (Fritz Suck).

Numerous workers from British North Borneo (E. B. Kershaw) and from Serambu Mt., Sarawak (H. W. Smith). A deälated female and five workers from Kuching (John Hewitt) are of a more reddish color.

125a. DOLICHODERUS (HYPOCLINEA) BITUBERCULATUS var. BORNEONENSIS (Roger).

Hypoclinea sellaris var. *borneonensis* Roger, Berl. ent. zeitschr., 1863, **7**, p. 214, ☿.

Type-locality: Borneo.

126. DOLICHODERUS (HYPOCLINEA) CONIGER Mayr.

Hypoclinea conigera Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 956, ☿.

Dolichoderus (*Hypoclinea*) *coniger* Emery, Gen. Ins. Dolichod., 1912, p. 13.

Type-locality: Sarawak, Borneo (Doria and Beccari).

A single worker from Mt. Matang, West Sarawak (John Hewitt).

127. Dolichoderus (Hypoclinea) cuspidatus (Smith).

Polyrhachis cuspidatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 63, ☿.
Hypoclinea cuspidata Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 955, ☿.
Dolichoderus cuspidatus Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 256, ☿.
Dolichoderus (Hypoclinea) cuspidatus Emery, Gen. Ins. Dolichod., 1912, p. 13.

Type locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari).

Several workers from Mt. Matang and the Rambungan River, Sarawak (H. W. Smith).

128. Dolichoderus (Hypoclinea) patens (Mayr).

Hypoclinea patens Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 957, ☿.
Dolichoderus patens Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 254.
Dolichoderus (Hypoclinea) patens Emery, Gen. Ins. Dolichod., 1912, p. 14.

Type-locality: Sarawak, Borneo (Doria and Beccari).

129. Dolichoderus (Hypoclinea) semirugosus (Mayr).

Hypoclinea semirugosa Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 956, ☿.
Dolichoderus semirugosus Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 254, ☿.
Dolichoderus (Hypoclinea) semirugosus Emery, Gen. Ins. Dolichod., 1912, p. 14.

Type-locality: Sarawak, Borneo (Doria and Beccari).

130. Dolichoderus (Hypoclinea) sulcaticeps (Mayr).

Hypoclinea sulcaticeps Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 957, ☿.
Dolichoderus sulcaticeps Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 254, ☿.
Dolichoderus (Hypoclinea) sulcaticeps Emery, Gen. Ins. Dolichod., 1912, p. 14.

Type-locality: Sarawak, Borneo (Doria and Beccari).
Several workers from Sadong, Sarawak (H. W. Smith).

*131. DOLICHODERUS (HYPOCLINEA) TAPROBANAE (Smith).

Formica taprobane Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 13, ♀.
Dolichoderus taprobanae Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 353.
Hypoclinea gracilis Motschulsky, Bull. Soc. nat. Moscou, 1863, **36**, p. 14, ☿.
Dolichoderus (*Hypoclinea*) *taprobanae* Emery, Gen. Ins. Dolichod., 1912, p. 14.

Type-locality: Ceylon.
Two workers from Kuching (John Hewitt).

131a. DOLICHODERUS (HYPOCLINEA) TAPROBANAE (Smith) var. BORNEËNSIS Forel.

Dolichoderus taprobanae var. *borneënsis* Forel, Rev. Suisse zool., 1911, **19**, p. 46, ☿.
Dolichoderus (*Hypoclinea*) *taprobanae* var. *borneënsis* Emery, Gen. Ins. Dolichod., 1912, p. 14.

Type-locality: Hayvep, Borneo (Winkler).

132. IRIDOMYRMEX ANCEPS (Roger).

Formica anceps Roger, Berl. ent. zeitschr., 1863, **7**, p. 164, ☿.
Iridomyrmex excisus Mayr, Tijdschr. ent., 1867, **10**, p. 77, ☿ ♀, pl. 2, fig. 8.
Hypoclinea (*Iridomyrmex*) *excisa* Mayr, Verh. Zool. bot. gesellsch. Wien, 1870, **20**, p. 959, ☿.
Iridomyrmex anceps Emery in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 169; Emery, Gen. Ins. Dolichod., 1912, p. 23.

Type-locality: Malacca.
Sarawak (Doria and Beccari).
Several workers and three females from Kuching (John Hewitt).

133a. IRIDOMYRMEX CORDATUS (Smith) subsp. PROTENSUS Forel.

Iridomyrmex cordatus subsp. *protensus* Forel, Rev. Suisse zool., 1911, **19**, p. 47, ☿ ♀ ♂; Emery, Gen. Ins. Dolichod., 1912, p. 24.

Type-locality: Sarawak, Borneo (Haviland).

*134a. Iridomyrmex myrmecodiae Emery.

Iridomyrmex cordatus var. *myrmecodiae* Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 249, ☿.
Iridomyrmex myrmecodiae Emery, ibid., 1900, ser. 2, **20**, p. 694; Emery, Gen. Ins. Dolichod., 1912, p. 25.

Type-locality: Java.

Numerous workers from British North Borneo (E. B. Kershaw) and a deälated female and two workers from Kuching (John Hewitt), found nesting in the rootstocks of a fern (*Polypodium sinuosus sinuosus*).

135. Tapinoma flavidum Ern. André.

Tapinoma flavidum Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 51, ☿; Emery, Gen. Ins. Dolichod., 1912, p. 41.

Type-locality: Kapouas Basin, Borneo (Chaper).

136. Tapinoma melanocephalum (Fabricius).

Formica melanocephala Fabricius, Ent. syst., 1793, **2**, p. 353, ♀.
Lasius melanocephalus Fabricius, Syst. Piez., 1804, p. 417.
Myrmica melanocephala Lepeletier, Hist. nat. ins. hyménop., 1836, **1**, p. 185.
Formica nana Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 125, ☿.
Micromyrma melanocephala Roger, Berl. ent. zeitschr., 1862, **6**, p. 258, ☿ ♀.
Myrmica pellucida Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 71, ☿.
Formica familiaris Smith, ibid., Suppl., 1860, **4**, p. 96 (*nec.* ibid., p. 68, ♀).
Tapinoma melanocephalum Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 651; Emery, Gen. Ins. Dolichod., 1912, p. 41.

Type-locality: Cayenne (Coll. Bosc.).
Kapouas Basin (Chaper).

*137. Tapinoma indicum Forel.

Tapinoma melanocephalum var. Mayr, Termesz. füzetek., 1897, **20**, p. 432, ☿.
Tapinoma indicum Forel, Journ. Bombay nat. hist. soc., 1895, **9**, p. 472, ☿; Bingham, Fauna Brit. India. Hymenop., 1903, **2**, p. 304, ☿; Emery, Gen. Ins. Dolichod., 1912, p. 41.

Tapinoma melanocephalum subsp. *indicum* Forel, Notes Leyden mus., 1911, **33**, p. 206.

Type-locality: Poona, India (Wroughton).
Several workers from Sarawak (Roland Thaxter).

138. TECHNOMYRMEX ALBIPES (Smith).

Formica (*Tapinoma*) *albipes* Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **6**, p. 38, ☿.
Tapinoma albipes Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 147; Emery, ibid., 1887, ser. 2, **4**, p. 249.
Technomyrmex albipes Emery, Zeitschr. wiss. zool., 1888, **46**, p. 392; Emery, Gen. Ins. Dolichod., 1912, p. 43.

Type-locality: Tondano, Celebes (A. R. Wallace).
Sarawak (Doria and Beccari); Kapouas Basin (Chaper).
Several workers from Sarawak (H. W. Smith) and one from Kuching (John Hewitt).

139. TECHNOMYRMEX STRENUUS Mayr.

Technomyrmex strenua Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 147, ☿ ♀.
Technomyrmex strenuus Emery, ibid., 1887, ser. 2, **4**, p. 248, ☿; Emery, Gen. Ins. Dolichod., 1912, p. 44, ☿ ♀, pl. 1, fig. 20, 20b.

Type-locality: Sarawak, Borneo (Doria and Beccari).
Sarawak (Haviland).
Four workers from Kuching (John Hewitt).

CAMPONOTINAE.

140. MYRMOTERAS DONISTHORPEI Wheeler.

Myrmoteras donisthorpei Wheeler, Proc. New Eng. zool. club, 1916, **6**, p. 14, ♀, fig. 3.

Type-locality: Mt. Matang, West Sarawak (G. E. Bryant).

141. PLAGIOLEPIS (ANOPLOLEPIS) LONGIPES (Jerdon).

Formica longipes Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 122, ☿.
Formica gracilipes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 55, ☿.

Formica trifasciata Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 27, ♀.
Prenolepis gracilipes Mayr, Verh. Zool. bot. gesellsch., Wien, 1862, **12**, p. 698.
Plagiolepis gracilipes Mayr, Tijdschr. ent., 1867, **10**, p. 73, ☿ ♀.
Plagiolepis longipes Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 247.
Plagiolepis (*Anoplolepis*) *longipes* Forel, Tijdschr. ent., 1915, **58**, p. 34.

Type-locality: India (Jerdon).

Sarawak (Doria and Beccari; Bedot and Pictet); Kapouas Basin (Chaper).

Numerous workers from Sandakan, Sadong and Mt. Matang, Sarawak (H. W. Smith), British North Borneo (E. B. Kershaw) and Kuching (John Hewitt).

142. APHOMOMYRMEX ANDREI (Emery).

Dimorphomyrmex andrei Emery, Ann. Soc. ent. France, 1894, p. 73, ♀:
Aphomomyrmex andrei Emery, Ann. Soc. ent. Belgique, 1899, **43**, p. 894, ♀; Wheeler, Psyche, 1910, **17**, p. 132, ♀.

Type-locality: Pulo Laut, Borneo.

143. APHOMOMYRMEX HEWITTI Wheeler.

Aphomomyrmex hewitti Wheeler, Psyche, 1910, **17**, p. 132, ☿ ♀, fig. 1.

Type-locality: Bidi, Borneo (John Hewitt).

144. GESOMYRMEX CHAPERI Ern. André.

Gesomyrmex chaperi Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 47, ☿. fig. 1–3.

Type-locality: Kapouas Basin, Borneo (Chaper).

145. DIMORPHOMYRMEX JANETI Enr. André.

Dimorphomyrmex janeti Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 51, ☿, fig. 4, 5; Wheeler, Psyche, 1910, **17**, p. 132, ☿.

Type-locality: Kapouas Basin, Borneo (Chaper).

*146. PRENOLEPIS JERDONI Emery.

Prenolepis jerdoni Emery, Rev. Suisse zool., 1893, **1**, p. 223, ☿, pl. 8, fig. 20.

Type-locality: Perak.

Three workers from Kuching (John Hewitt).

*147. PRENOLEPIS (NYLANDERIA) LONGICORNIS (Latreille).

Formica longicornis Latreille, Hist. nat. fourmis, 1802, p. 113, ☿.
Formica vagans Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 124, ☿ ♀.
Formica (*Tapinoma*) *gracilescens* Nylander, Ann. sci. nat. Zool., 1856, ser. 4, **5**, p. 73, ☿, pl. 3, fig. 20.
Formica gracilescens Nylander, Ann. Soc. ent. France, 1856, ser. 3, **4**, Bull., p. XXVIII, ☿.
Tapinoma gracilescens Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 56.
Prenolepis gracilescens Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 698.
Paratrechia currens Motschulsky, Bull. Soc. nat. Moscou, 1863, **36**, p. 14.
Prenolepis longicornis Roger, Verzeichn. formicid., 1863, p. 10.
Prenolepis (*Nylanderia*) *longicornis* Santschi, Voy. Allmand et Jeamel Afr. Orient. Formicid., 1914, p. 127, ☿.

Type-locality: Senegal (Bosc.).

Seven workers from Sarawak (Roland Thaxter).

148. PRENOLEPIS (NYLANDERIA) OBSCURA Mayr.

Prenolepis obscura Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 698, ☿ ♀.

Type-locality: Sydney, New South Wales (Novara Expedition).

Kapouas Basin, Borneo (Chaper).

*149. PRENOLEPIS (NYLANDERIA) KRAEPELINI Forel.

Prenolepis kraepelini Forel, Mitth. Naturh. mus. Hamburg, 1905, **22**, p. 24, ☿ ♀ ♂.

Type-locality: Buitenzorg, Java (Kraepelin).

Two workers from Kuching (John Hewitt), "nesting in fungus," and one from Sarawak (Roland Thaxter). Another worker from Mt. Matang (G. E. Bryant) appears to belong to the same species but is considerably larger (2.6 mm.).

150a. PRENOLEPIS (NYLANDERIA) BUTTELI Forel subsp. BRYANTI Forel.

Prenolepis (*Nylanderia*) *butteli* Forel subsp. *bryanti* Forel, Rev. Suisse zool. 1916, **24**, p. 439, ☿.

Type-locality: Mt. Matang, West Sarawak (G. E. Bryant).
Worker. Length 1.5 mm.

Head subrectangular, as broad as long, nearly as broad in front as behind with rounded sides and posterior corners and feebly convex posterior border. Eyes moderately large, flat, just behind the middle of the sides. Mandibles narrow, with straight external and short, minutely 5-toothed apical borders. Clypeus very convex, but not carinate, its anterior border entire and rounded. Frontal carinae short, as far apart as their distance from the sides of the head. Antennae slender, scapes extending about $\frac{1}{6}$ their length beyond the occipital border of the head; second funicular joint small, broader than long, joints 3–6 a little longer than broad. Thorax short, with distinct promesonotal and mesoëpinotal sutures, very feeble and short mesoëpinotal constriction, the pro- and mesonotum rather flat; the epinotum with very short and transverse, feebly convex base, passing rapidly into the long sloping declivity. Petiole with very short, low node, a mere anteriorly directed projection at the anterior end of the segment, much as in some species of Tapinoma. Gaster with the first segment concave in front and lying over the petiole.

Head and thorax subopaque; mandibles, legs, antennae, and gaster more shining; mandibles sparsely and finely punctate; the head, thorax, and gaster distinctly shagreened, the gaster transversely.

Hairs dark brown, coarse, sparse, erect, blunt, except on the anterior portion of the head; body without, antennae and legs with extremely short, appressed, whitish pubescence.

Castaneous brown; head, thorax, and gaster with pronounced metallic reflections, the head and pronotum more blue, the gaster and remainder of the thorax more violet. Mandibles, antennae, tarsi, middle and hind tibiae, knees, and ends of tibiae of fore legs, and tips of hind femora whitish yellow.

A single specimen from Sarawak, received from Prof. Roland Thaxter.

Forel's description is very brief and is hidden away in the midst of a paper devoted to Congolese ants!

151. PSEUDOLASIUS MAYRI Emery.

Lasius familiaris Mayr, Reise Novara. Zool., **2**. Formicid., 1865, p. 55, ♀ (*nec* Smith).

Pseudolasius familiaris Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 245, *nota*, ☿ (*nec* Smith *nec* ♀).
Pseudolasius mayri Emery, Ann. Soc. ent. Belgique, 1911, **55**, p. 215, ☿ ♀ ♂.

Type-locality: Buitenzorg, Java.
Sarawak (Coll. Emery).

151a. PSEUDOLASIUS MAYRI var. SARAWAKANUS Forel.

Pseudolasius mayri var. *sarawakana* Forel, Zool. jahrb. Syst., 1913, **36**, p. 107 *nota*, ♀ ♂.

Type-locality: Sarawak, Borneo (Haviland).

152. OECOPHYLLA SMARAGDINA (Fabricius).

Formica smaragdina Fabricius, Syst. ent., 1775, p. 828, ♀.
Formica macra Guérin, Duperry Voy. Coquille. Zool., 1830, **2**, p. 202, ☿, pl. 8, fig. 1.
Formica zonata Guérin, ibid., p. 205, ♀.
Oecophylla smaragdina Smith, Journ. Proc. Linn. soc. London. Zool. Suppl., 1860, **4**, p. 102, ☿.

Type-locality: India (Edler).
Sarawak (Doria and Beccari; Bedot and Pictet; A. R. Wallace).

Numerous workers from British North Borneo (E. B. Kershaw); and a deälated female and workers from Kuching and Sadong (H. W. Smith).

153. CALOMYRMEX LAEVISSIMUS (Smith).

Formica laevissima Smith, Journ. Proc. Linn. soc. London. Zool., 1859, **3**, p. 138, ☿.
Camponotus laevissimus Mayr, Tijdschr. ent., 1867, **10**, p. 39, ☿, pl. 2, fig. 1.
Colobopsis levissima Roger, Verzeich. formicid., 1863, p. 10.
Calomyrmex laevissimus Emery, Mem. R. accad. sci. Bologna, 1896, 1895–1896, ser. 5, **5**, p. 776.

Type-locality: Aru (A. R. Wallace).
Borneo (*teste* Roger).

154. CAMPONOTUS (DINOMYRMEX) GIGAS (Latreille).

Formica gigas Latreille, Hist. nat. fourmis, 1802, p. 105, ♀, pl. 2, fig. 6.
Camponotus gigas Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 669, ☿.
Camponotus (*Dinomyrmex*) *gigas* Forel, Rev. Suisse zool., 1914, **22**, p. 268.

Type-locality: "Grandes-Indes" (Riche).

Several workers from British North Borneo (E. B. Kershaw) and from the Silimpopon River (Hugh M. Smith).

154a. CAMPONOTUS (DINOMYRMEX) GIGAS subsp. BORNEËNSIS Emery.

Camponotus gigas subsp. *borneënsis* Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 214, ☿ ♀ ♂.

Type-locality: Sarawak, Borneo (Doria and Beccari).

Kapouas Basin (Chaper); Poeloe Island, E. Borneo (P. Jachan).

Numerous workers from Kuching, Sadong, and the Rambungan River, Sarawak (H. W. Smith) and a single worker from Kuching (John Hewitt).

155. CAMPONOTUS (DINOMYRMEX) ANGUSTICOLLIS (Jerdon).

Formica angusticollis Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 120, ♃ ☿ ♀.

Formica ardens Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 17, ♀.

Formica impetuosa Smith, ibid., p. 18, ☿.

Formica callida Smith, ibid., p. 18, ☿.

Camponotus prismaticus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 669, ☿.

Camponotus angusticollis Roger, Verzeichn. formicid., 1863, p. 3; Dalla Torre, Cat. Hymenop., 1893, **7**, p. 221.

Camponotus ardens Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 353.

Camponotus (*Dinomyrmex*) *angusticollis* Forel, Rev. Suisse zool., 1914, **22**, p. 268.

Type-locality: Malabar, Southern India (Jerdon).

Borneo (Mus. Caes.).

156. CAMPONOTUS (MYRMOTURBA) FESTINUS (Smith).

Formica festina Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 53, ♀.

Camponotus festinus Roger, Verzeich. formicid., 1863, p. 3; Dalla Torre, Cat. Hymenop., 1893, **7**, p. 231.

Camponotus (*Myrmoturba*) *festinus* Forel, Rev. Suisse zool., 1914, **22**, p. 267.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari; Bedot and Pictet).

Two major workers and one minor from Kuching (John Hewitt), one major from British North Borneo (E. B. Kershaw) and a minor from Sadong, Sarawak (H. W. Smith) agree in measurements with the type of this species as defined by Emery. Smith unfortunately based the species on a female, so that, as Emery says, examination of the type would probably give no clue as to whether it belonged to this form or to the subspecies described by the Italian myrmecologist as subsp. *eximius* from Sumatra.

*156a. CAMPONOTUS (MYRMOTURBA) FESTINUS subsp. EXIMIUS Emery.

Camponotus festinus subsp. *eximius* Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 701, ☿.

Type-locality: Si Rambe, Sumatra (E. Modigliani).

A single worker major from Kuching (John Hewitt).

*157. CAMPONOTUS (MYRMOTURBA) AUTRANI Forel.

Camponotus autrani Forel, Ann. Soc. ent. Belgique, 1886, **30**, p. 165, ☿.

Camponotus festinus subsp. *autrani* Emery, Ann. Mus. civ. Genova, 1888, ser. 2, **5**, p. 528, ☿.

Camponotus (*Myrmoturba*) *autrani* Forel, Rev. Suisse zool., 1914, **22**, p. 266.

Type-locality: Sumatra (Conrad Klaesi).

Two major workers from Sadong, Sarawak (H. W. Smith).

158. CAMPONOTUS (MYRMOTURBA) SUCKI Forel.

Camponotus sucki Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 71, ☿.

Camponotus (*Myrmoturba*) *sucki* Forel, Rev. Suisse zool., 1914, **22**, p. 267.

Type-locality: Tandjong, S. E. Borneo (Fritz Suck).

159a. CAMPONOTUS (MYRMOTURBA) MACULATUS Fabricius subsp. SETITIBIA Forel.

Camponotus maculatus race *setitibia* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 68, ☿.

Type-locality: Tandjong, S. E. Borneo (Fritz Suck).

159b. CAMPONOTUS (MYRMOTURBA) MACULATUS subsp. IRRITANS (Smith).

Formica irritans Smith, Journn. Proc. Linn. soc. London. Zool., 1857, **2**, p. 55, ☿.
Camponotus irritans Roger, Verzeichn. formicid., 1863, p. 3.
Camponotus inconspicuus Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 135, ☿.
Camponotus (*Myrmoturba*) *maculatus* subsp. *irritans* Forel, Rev. Suisse zool., 1914, **22**, p. 267.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Doria and Beccari; Bedot and Pictet).
Numerous workers and a female from Kuching (H. W. Smith).

159c. CAMPONOTUS (MYRMOTURBA) MACULATUS subsp. IRRITANS var. INFERIOR Forel.

Camponotus maculatus subsp. *irritans* var. *inferior* Forel, Rev. Suisse zool., 1911, **19**, p. 48, ☿ ♀.

Type-locality: Sarawak, Borneo (Haviland).
Several workers from Kuching (John Hewitt).

159d. CAMPONOTUS (MYRMOTURBA) MACULATUS subsp. COMPRESSUS (Fabricius).

Formica compressa Fabricius, Mant. Ins., 1787, **1**, p. 307, ☿.
Formica indefessa Sykes, Trans. Ent. soc. London, 1835, **1**, p. 104, ☿, pl. 13, fig. 3.
Camponotus compressus Roger, Verzeichn. formicid., 1863, p. 2.
Camponotus quadrilaterus Roger, Berl. ent. zeitschr., 1863, **7**, p. 136, ☿.
Camponotus maculatus subsp. *compressus* Emery, in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 226.

Type-locality: Tranquebar (Hybner).
Sarawak (A. R. Wallace).

160. CAMPONOTUS (MYRMOTURBA) PALLIDUS (Smith).

Formica pallida Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 57, ☿.
Camponotus pallidus Mayr, Verh. Zool. bot. gesellsch. Wien, 1863, **13**, p. 400; Forel, Journ. Bombay nat. hist. soc., 1892, **7**, p. 21, ☿; Emery, Mem. R. accad. sci. Bologna, 1896, 1895–1896, ser. 5, **5**, p. 769.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari); Kapouas Basin (Chaper).

A single worker from Kuching (John Hewitt) from a colony "nesting in a bunch of ratan fruits."

161. CAMPONOTUS (MYRMOTURBA?) FERVENS (Smith).

Formica fervens Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 55, ☿.

Camponotus fervens Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 354.

Camponotus (*Myrmoturba*?) *fervens* Forel, Rev. Suisse zool., 1914, **22**, p. 267.

Type-locality: Sarawak, Borneo (A. R. Wallace).

162. CAMPONOTUS (MYRMOTARSUS) MISTURA (Smith).

Formica mistura Smith, Journ. Proc. Linn. soc. London, Zool., 1857, **2**, p. 53, ♀.

Formica exasperata Smith, ibid., p. 56, ☿.

Camponotus exasperatus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 659, ☿.

Camponotus mistura Mayr, ibid., 1886, **36**, p. 354.

Camponotus (*Myrmotarsus*) *mistura* Forel, Rev. Suisse zool., 1914, **22**, p. 269.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari; Haviland).

A female from British North Borneo (E. B. Kershaw) and one from Kuching (H. W. Smith).

163. CAMPONOTUS (MYRMOTARSUS) RUFIFEMUR Emery.

Camponotus rufifemur Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 705, ☿.

Camponotus (*Myrmotarsus*) *rufifemur* Forel, Rev. Suisse zool., 1914, **22**, p. 269.

Type-locality: Mentawei (E. Modigliani).

Sarawak, Borneo.

A major worker from Kuching (John Hewitt) and a major and minor worker from the Rambungan River (H. W. Smith).

164. CAMPONOTUS (MYRMOTARSUS) PRESSIPES Emery.

Camponotus pressipes Emery, Ann. Soc. ent. France, 1893, p. 268 *nota*, ♀.

Camponotus (*Myrmotarsus*) *pressipes* Forel, Rev. Suisse zool., 1914, **22**, p. 269.

Type-locality: Borneo.

Tandjong, S. E. Borneo (Fritz Suck).

Three females from Kuching (H. W. Smith).

165. CAMPONOTUS (MYRMOTARSUS) IRRITABILIS (Smith).

Formica irritabilis Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 56, ☿.
Camponotus irritabilis Roger, Verzeichn. formicid., 1863, p. 3.
Camponotus (*Myrmotarsus*) *irritabilis* Forel, Rev. Suisse zool., 1914, **22**, p. 269.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Sarawak (Doria and Beccari).

Several workers from Kuching (John Hewitt) and the Rambungan River, Sarawak (H. W. Smith) and a single worker transitional to the var. *sedulus* from British North Borneo (E. B. Kershaw).

165a. CAMPONOTUS (MYRMOTARSUS) IRRITABILIS var. SEDULUS (Smith).

Formica sedula Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 56, ☿.
Camponotus sedulus Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 136, ☿ ♀.
Camponotus irritabilis var. *sedulus* Forel, Rev. Suisse zool., 1911, **19**, p. 51.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Four major workers from the Rambungan River, Sarawak (H. W. Smith).

165b. CAMPONOTUS (MYRMOTARSUS) IRRITABILIS var. WINKLERI Forel.

Camponotus irritabilis var. *winkleri* Forel, Rev. Suisse zool., 1911, **19**, p. 51, ☿.

Type-locality: Hayvep, Borneo (Winkler).

166. CAMPONOTUS (MYRMOPHYMA) QUADRISECTUS (Smith).

Formica quadrisecta Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 28, ♀.
Camponotus gilviceps Mayr, Tijdschr. ent. 1867, **10**, p. 5, ☿.
Camponotus quadrisectus Forel, Ann. Soc. ent. Belgique, 1909, **53**, p. 57 *nota*.
Camponotus (*Myrmophyma*) *quadrisectus* Forel, Rev. Suisse zool., 1914, **22**, p. 269.

Type-locality: Philippine Islands.

Borneo (Leyden Mus.).

A soldier and two minor workers from Baram, Borneo (John Hewitt) taken from the "distorted pseudobulb of a Myrmecodia."

Forel assigns this species to his subgenus Myrmophyma, of which he has designated it as the type, but it seems to me to belong more naturally in Myrmotarsus, owing to the peculiar compression of the hind metatarsi and the shape of the head. Emery had previously (Mem. R. accad. sci. Bologna, 1896, ser. 5, **5**, p. 773) placed the species in his manipulus 11 of Camponotus with *mistura* Roger, *platypus* Roger, etc.

167. CAMPONOTUS (MYRMOPHYMA) EXSECTUS Emery.

Camponotus exsectus Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 709, fig. 15, ☿ ♀.

Type-locality: Sipora, Mentawei (E. Modigliani).

Pulo Laut, Borneo (Coll. Emery).

168. CAMPONOTUS (MYRMOMALIS) CONTRACTUS Mayr.

Camponotus contractus Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 137, ☿.

Camponotus (*Myrmomalis*) *contractus* Forel, Rev. Suisse zool., 1914, **22**, p. 271.

Type-locality: Sarawak, Borneo (Doria and Beccari).

169a. CAMPONOTUS (MYRMAMBLYS) RETICULATUS Roger subsp. BEDOTI Emery.

Camponotus bedoti Emery, Rev. Suisse zool., 1893, **1**, p. 196, ☿, pl. 8, fig. 2.

Camponotus reticulatus subsp. *yerburyi* var. *bedoti* Emery, Mem. R. accad. sci. Bologna, 1896, 1895–1896, ser. 5, **5**, p. 772.

Camponotus (*Myrmamblys*) *reticulatus* subsp. *bedoti* Forel, Rev. Suisse zool., 1914, **22**, p. 271.

Type-locality: Batjan.

Sarawak (Bedot and Pictet).

170. CAMPONOTUS (MYRMOSPHINCTA) CAMELINUS (Smith).

Formica camelina Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 57 ☿.

Camponotus senilis Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 675, ☿, pl. 19, fig. 3.

Camponotus camelinus Roger, Verzeichn. formicid., 1863, p. 3.

Camponotus singularis var. *camelinus* Emery, Ann. Mus. civ. Genova, ser. 2, **4**, 1887, p. 210.

Camponotus cinerascens var. *camelinus* Dalla Torre, Cat. Hymenop., 1893, **7**, p. 224.

Camponotus (*Myrmosphincta*) *camelinus* Forel, Mem. Soc. ent. Belgique, 1912, **20**, p. 92.

Camponotus (*Myrmocamelus*) *camelinus* Forel, Rev. Suisse Zool., 1914, **22**, p. 270.

Type-locality: Singapore (A. R. Wallace).

Kapouas Basin, Borneo (Chaper).

Numerous workers from British North Borneo (E. B. Kershaw) and Serambu Mt., Sarawak (H. W. Smith).

170a. CAMPONOTUS (MYRMOSPHINCTA) CAMELINUS var. SINGULARIS (Smith).

Formica singularis Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 27, ☿.

Camponotus cinerascens Roger, Verzeich. formicid., 1863, p. 3; Dalla Torre, Cat. Hymenop. 1893, **7**, p. 224; Emery, Mem. R. accad. sci. Bologna, 1896, 1895–1896, ser. 5, **5**, p. 771.

Camponotus singularis Mayr, Tijdschr. ent., 1867, **10**, p. 39, ☿.

Type-locality: Java.

Sarawak (Doria and Beccari).

A worker from Matang Mt., W. Sarawak (H. W. Smith) and one from Kuching (John Hewitt).

171. CAMPONOTUS (MYRMOSPHINCTA) DOLICHODEROIDES Forel.

Camponotus dolichoderoides Forel, Rev. Suisse zool., 1911, **19**, p. 51, ☿.

Camponotus (*Myrmosphincta*) *dolichoderoides* Forel, Rev. Suisse zool., 1914, **22**, p. 273.

Type-locality: Hayvep, Borneo (Winkler).

172. CAMPONOTUS (MYRMOSPHINCTA) HYPOCLINEOIDES, sp. nov.

Worker minor. Length 5.3 mm.

Slender; head nearly $1\frac{1}{2}$ times as long as broad, with the sides in front of the moderately large and convex eyes, which are just anterior to the posterior third of the head, rather straight and parallel, behind the eyes gradually contracted to a narrow, marginate, but not colliform posterior border; in profile very convex above and flat below. Mandibles narrow, feebly convex, with straight external borders, their apical borders apparently 6-toothed. Both the maxillary and labial palpi very long. Clypeus subcarinate behind, its median portion trapezoidal, a little broader than long, its lateral portions very narrow and reaching to the anterior corners of the head, its anterior border straight and entire. Clypeal foveae small and deep. Frontal area large, semicircular, rather indistinct. Frontal carinae sigmoidal, at their greatest curvature fully as far apart as their distance from the lateral borders of the head. Antennae long and slender, inserted well behind the clypeal border, the nearly straight scapes extending about half their length beyond the occipital border of the head. Thorax shaped like that of Hypoclinea, broadest through the pronotum which, including the neck, is as long as broad, evenly rounded and convex above; mesonotum broadly and deeply constricted behind, the anterior dorsal outline in profile falling rather steeply with an even curve from the pronotum to the depression in which lie the two very prominent metathoracic stigmata. Epinotum about as broad as the mesonotum, only a little lower than the pronotum, with subequal base and declivity, the former longitudinally and transversely rounded, rising rather steeply in front and meeting the latter at a right angle which is neither sharp nor marginate. Petiole narrow, as long as high, the node at its anterior end, erect and very blunt and rounded, lower than the epinotum. Gaster elliptical. Legs long and slender, distinctly compressed, tibiae without bristles on their flexor surfaces.

Shining; mandibles subopaque, very finely and sparsely punctate; gaster transversely alutaceous, with sparse, piligerous punctures.

Hairs long, erect, rather abundant, in part very long and flexuous on the dorsal surface of the head, thorax, and petiole, whitish, with brown bases in some lights, shorter on the front and sides of the head; long, abundant, and oblique on the scapes and legs. Pubescence yellowish, confined to the antennal funiculi.

Brown; fore tibiae and bases of middle and hind tibiae paler; neck, mandibles, except the teeth, cheeks, anterior border of clypeus, antennal funiculus except the basal half of the first joint, whitish yellow; posterior portion of clypeus and antennal insertions somewhat darker; palpi dark brown, with pale articulations.

Described from a single specimen taken on Mt. Matang, W. Sarawak by Prof. Harrison W. Smith.

This species is related to *C. dolichoderoides* Forel but is smaller, shining and with very different pilosity and very differently shaped head and petiole. It is also very different from *C. horrens* Forel of the Philippines and *moeschi* Forel of Sumatra.

173. CAMPONOTUS (MYRMOSPHINCTA) MEGALONYX, sp. nov.

Worker major. Length about 7 mm.

Robust; head large, trapezoidal, broad behind and narrow in front, with straight, anteriorly converging sides and deeply excised posterior border, high and convex in the region of the vertex, with the posterior corners and lateral borders feebly depressed. Eyes on the dorsal surface behind the median transverse diameter of the head, rather small, moderately convex. Mandibles stout and convex, their apical borders long, 6-toothed. Clypeus rather flat, subcarinate behind, the median portion subhexagonal, as long as broad, the lateral portions short, triangular, far from reaching the anterior corners of the head; the anterior border sinuately excised on each side, with a short, narrow, rounded lobe in the middle. Clypeal foveae pronounced. Frontal area large, subtriangular; frontal groove very distinct. Frontal carinae sinuous, diverging behind. Antennae short and stout; scapes feebly curved, narrow, and terete at the base, gradually thickened towards their tips, not reaching the posterior border of the head. Thorax very short; pronotum broad, narrower than the head, convexly rounded, excluding the neck twice as broad as long; mesonotum very short, broader than long, bordered anteriorly by a strong semicircular, promesonotal suture, rapidly sloping in profile to a deep, narrow constriction only as broad as the prominent metanotal stigmata on each side of it. Epinotum subcuboidal, only half as broad as the pronotum, higher than long, with flat sides; in profile with the base abruptly truncated in front, straight and horizontal above and forming a right angle with the flattened, truncated declivity which is narrowed below. Petiole higher than long, subcuboidal, much lower than the epinotum, the node thick, higher than long, the anterior surface slightly concave and higher than the posterior surface, the dorsal surface rounded and sloping backward and downward. Gaster broadly elliptical, smaller than the head, somewhat flattened. Legs stout, the terminal tarsal joint, claws, and empodia noticeably enlarged; tibiae slightly flattened but not chanelled, without a row of bristles on their flexor surfaces.

Opaque; head and gaster slightly lustrous; very finely, densely, and evenly punctate, with sparser piligerous punctures, abundant and transverse on the gaster. Mandibles and legs shining, very finely and superficially shagreened, the mandibles also coarsely and sparsely punctate and near their apical margins coarsely striate; legs with sparse piligerous punctures.

Hairs reddish, rather abundant, erect; long and flexuous on the thoracic dorsum and first gastric segment, shorter elsewhere; absent on the cheeks and almost absent on the antennal scapes, present on the gula and legs. Pubescence long and abundant but nowhere concealing the sculpture, conspicuous on the posterior portion of the head, the thorax and gaster.

Black; thorax and petiole dark brown; upper surface of epinotum and some spots on the pleurae ferruginous; coxae and femora brownish yellow; tibiae, tarsi, and funiculi dark brown; terminal tarsal joints, claws, and empodia reddish.

Worker minor. Length nearly 5 mm.

Very similar to the major worker, except that the head is much smaller, proportionally longer, with straight posterior border, more prominent eyes and the antennal scapes extending about $\frac{1}{6}$ their length beyond the occipital border. The epinotal declivity is slightly concave and a little more sloping, the petiolar node is decidedly thinner. The thorax and legs are dark brown, except the articulations of the latter and the tarsi beyond the basal joint, which are reddish. The erect hairs on the legs are somewhat less numerous.

Described from two major and two minor workers taken by Mr. William Beebe on the Mujong River, Sarawak, "running on bushes."

Like the preceding, this is a very peculiar species, which I have placed in Forel's subgenus Myrmosphincta on account of its thoracic structure. In my opinion this subgenus is an unnatural assemblage of forms, but in the present stage of myrmecology it is useful as a catch-all for the species with markedly sellate thorax. The tarsi and claws of *C. megalonyx* show that it is a true arboreal ant. It exhibits certain peculiarities in the structure of the clypeus and thorax that recall the conditions in Colobopsis.

174. Camponotus (Colobopsis) pilosus (Smith).

Formica pilosa Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 54, ☿.
Colobopsis pubescens Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 691, ☿ ♀ (*nec* Fabricius).
Camponotus pubescens Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 517.
Camponotus (*Colobopsis*) *leonardi* Emery, ibid., p. 515, ♀.
Camponotus (*Colobopsis*) *pilosus* Forel, Rev. Suisse zool., 1914, **22**, p. 272.

Type-locality: Sarawak, Borneo (A. R. Wallace).

Kapouas Basin (Chaper).

Soldiers, workers, and females from British North Borneo (E. B. Kershaw), Kuching and Rambungan River (H. W. Smith).

175. Camponotus (Colobopsis) badius (Smith).

Formica badia Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 54, ☿.
Camponotus badius Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 354.
Camponotus (*Colobopsis*) *badius* Forel, Rev. Suisse zool., 1914, **22**, p. 272.

Type-locality: Singapore (A. R. Wallace).

Sarawak (A. R. Wallace).

A worker from Kuching and one from the Rambungan River (H. W. Smith).

176. CAMPONOTUS (COLOBOPSIS) CLERODENDRI Emery.

Colobopsis clerodendri Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 241, ♃ ☿, fig.

Camponotus (*Colobopsis*) *clerodendri* Emery, ibid, 1889, ser. 2, **7**, p. 517; Forel, Rev. Suisse zool., 1914, **22**, p. 272.

Camponotus clerodendri Dalla Torre, Cat. Hymenop., 1893, **7**, p. 225.

Type-locality: Sarawak, Borneo (Doria and Beccari).

Two soldiers and two workers from Kuching (John Hewitt). A note accompanying the specimens states that "this ant vomits a yellow, sticky juice."

177. CAMPONOTUS (COLOBOPSIS) DORIAE Mayr.

Camponotus doriae Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 137, ☿.

Camponotus (*Colobopsis*) *doriae* Forel, Rev. Suisse zool., 1914, **22**, p. 272.

Type-locality: Sarawak, Borneo (Doria and Beccari).

Two workers from Kuching (John Hewitt).

178. CAMPONOTUS (COLOBOPSIS) FASCIATUS Mayr.

Colobopsis fasciata Mayr, Tijdschr. ent., 1867, **10**, p. 57, ♀.

Camponotus (*Colobopsis*) *fasciatus* Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 517.

Type-locality: Java (Leyden Museum).

Kapouas Basin, Borneo (Chaper).

*179. CAMPONOTUS (COLOBOPSIS) SAUNDERSI Emery.

Camponotus (*Colobopsis*) *saundersi* Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 516, ☿.

Type-locality: Thagatà, Tenasserim (L. Fea).

Six minor workers from the Sarawak River, near Kuching (H. W. Smith).

*180. CAMPONOTUS (COLOBOPSIS) VITREUS (Smith).

Formica vitrea Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **5**, p. 94, ☿.
Camponotus vitreus Emery, in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 257.
Camponotus (*Colobopsis*) *vitreus* Forel, Rev. Suisse zool., 1914, **22**.

Type-locality: Batjan (A. R. Wallace).
A single worker from British North Borneo (E. B. Kershaw).

181. CAMPONOTUS (COLOBOPSIS) STRICTUS (Jerdon).

Formica stricta Jerdon, Madras Journ. lit. sci., 1851, **17**, p. 123, ☿.
Colobopsis stricta Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 353.
Camponotus strictus Dalla Torre, Cat. Hymenop. 1893, **7**, p. 253.
Camponotus (*Colobopsis*) *strictus* Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 517.

Type-locality: Malabar, Southern India (Jerdon).
Sarawak (A. R. Wallace).

182. CAMPONOTUS (COLOBOPSIS) VIGILANS (Smith).

Formica vigilans Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 26, ☿.
Colobopsis vigilans Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 354.
Camponotus (*Colobopsis*) *vigilans* Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 517.
Camponotus vigilans Dalla Torre, Cat. Hymenop., 1893, **7**, p. 257.

Type-locality: Sarawak, Borneo.

*183. CAMPONOTUS (COLOBOPSIS) LEUCODISCUS, sp. nov.

Female (deälated). Length 5 mm.

Head subrectangular, longer than broad, broader behind than in front, with straight posterior and lateral borders, indistinctly truncate in front and convex dorsally. Eyes large, behind the middle of the head, separated by a distance equal to their length from the anterior corners of the head. Mandibles convex, with 5 subequal teeth. Clypeus flat, ecarinate, subrectangular, a little longer than broad, as broad behind as in front, its lateral borders notched just in front of the middle at the deep, pit-like clypeal foveae, the anterior border rounded and entire. Frontal area lozenge-shaped; frontal groove distinct but not reaching the anterior ocellus. Frontal carinae sinuous, diverging behind. Antennae inserted some distance behind the clypeus; the scapes terete, slightly thickened at their tips, reaching a little beyond the posterior corners of the head; funicular joints all very distinctly longer than broad. Thorax very regularly elongate-elliptical, nearly 2½ times as long as broad, as broad as the head. Mesonotum convex and rounded in front, flattened behind, as long as broad. Epinotum with distinct base and declivity, the former about half as long as the latter, meeting it at a rounded right angle. Petiole low and small, the node very blunt and rounded, about twice as broad as long. Gaster regularly elliptical, a little shorter and broader than the thorax. Legs rather short.

Subopaque; head in front and especially the mandibles more shining; mandibles and clypeus very finely and sparsely punctate; remainder of the body very finely and densely punctate, with coarser, sparse, piligerous punctures, most distinct on the front and posterior portion of the head.

Head, thorax, and gaster with very sparse, delicate, erect, blunt, blackish hairs; antennae and legs with short, sparse, appressed, rather indistinct, pale pubescence.

Black or very dark brown; mandibles, except their teeth, clypeus, cheeks, sides of front, antennae and their insertions, reddish yellow. Gaster milk-white, dorsal surface black, with a large, median, irregularly elliptical white spot, extending from the anterior third of the first to the posterior border of the fourth segment; the posterolateral margins of the second to fourth segments also white; anal segment black, with yellowish tip. Wing-insertions, coxae, and trochanters white; tarsi, anterior surface of the fore legs and ventral portions of the fore femora brownish yellow.

Described from a single specimen taken by Mr. E. B. Kershaw in British North Borneo.

This species is readily distinguished by its unusual coloration from any of the Colobopsis of which I have seen specimens or descriptions. Its small size indicates that the workers must be diminutive, like those of the European and North American species.[1]

184. CAMPONOTUS (COLOBOPSIS) GILVICEPS Roger.

Formica ruficeps Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 54, ☿ (*nec* Fabricius).

Camponotus gilviceps Roger, Verzeichn. formicid., 1863, p. 3; Forel, Ann. Soc. ent. Belgique, 1909, **53**, p. 57 *nota*.

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[1] Since the foregoing description was written I have received from Dr. J. W. Chapman a fine series of the soldiers and workers of this ant taken at Dumaguete, Negros Oriental, in The Philippines. The soldiers are colored like the female, but in the worker the white gastric spot is shorter, extending only to or slightly beyond the posterior margin of the second segment.

Camponotus (*Colobopsis*) *gilviceps* Forel, Rev. Suisse zool., 1914, **22**, p. 272.

Type-locality: Sarawak, Borneo (A. R. Wallace).

185. CAMPONOTUS (COLOBOPSIS) HOSEI Forel.

Camponotus hosei Forel, Rev. Suisse zool., 1911, **19**, p. 55, ☿.
Camponotus (*Colobopsis*) *hosei* Forel, ibid., 1914, **22**, p. 272.

Type-locality: Borneo (Hose).

186. CAMPONOTUS (COLOBOPSIS) HOSEI var. MIMUS Forel.

Camponotus hosei var. *mimus* Forel, Rev. Suisse zool., 1911, **19**, p. 56, ♀.

Type-locality: Borneo (Hose).

187. CAMPONOTUS (COLOBOPSIS) SEVERINI Forel.

Camponotus (*Colobopsis*) *severini* Forel, Ann. Soc. ent. Belgique, 1909, **53**, p. 55, ♃ ☿ ♀ ♂.

Type-locality: Labuan Island, Borneo.

188. CAMPONOTUS (COLOBOPSIS) SMITHIANUS, sp. nov.

Worker major. Length 5–5.6 mm.

Head large, regularly oblong, 1½ times as long as broad, equally flattened above and below, obliquely truncated in the clypeal region, with the cheeks swollen and rounded and their borders projecting anteriorly around the insertions of the mandibles as curved plates; the region in front of the eyes and near the frontal carinae distinctly impressed on each side; the eyes rather small and flat, their anterior orbits just in front of the posterior third of the head. Mandibles very stout and convex, with five obtuse teeth. Palpi very short. Clypeus with distinct median and lateral portions, the former ecarinate, consisting of two planes, a posterior continuing the dorsal surface of the head, rectangular and nearly twice as broad as long, and an anterior, obliquely sloping and semicircular, its median curved edge forming the anterior border of the clypeus. The triangular, scale-like lateral portions of the clypeus are marked off by grooves that terminate behind in the small but distinct clypeal foveae. Frontal area indistinct; frontal groove delicate; frontal carinae long, lyriform, continued nearly as far back as the posterior orbits, diverging behind where they are twice as far apart as their distance from the lateral corners of the head. Antennae short and slender, the scapes uniformly bent, slightly flattened though narrow at the base, gradually enlarging towards their tips, which reach the posterior corners of the head; funiculi of very uniform thickness throughout, the joints subequal, a little longer than broad, the first and last longer. Thorax much narrower and a little shorter than the head, the pro- and mesonotum together forming a hemispherical mass, with strong mesoëpinotal suture, the mesonotum broader than long. Mesoëpinotal constriction rather deep and very short; metanotal sclerite distinct, short, and convex; epinotum very small, its base long, flattened, nearly perpendicular, the declivity extremely short and strongly concave. Petiole thick, and very low; from above twice as broad as long and a little narrower in front than behind, in profile truncated anteriorly, posteriorly, and dorsally, the posterior surface higher than the anterior and distinctly impressed in the middle above. Gaster elongate-elliptical, smaller than the head. Legs rather stout, slightly flattened, the fore femora enlarged, the claws well developed.

Mandibles shining, finely and evenly but not densely punctate; anterior half of head subopaque, densely and finely punctate and minutely and indistinctly rugulose; remainder of body shining, distinctly shagreened, the gaster transversely, covered with sparse, piligerous punctures.

Hairs grayish, coarse, erect, of uneven length, longest and moderately abundant on the dorsal surface of the head, thorax, petiole, and gaster; absent on the gula; short, even, and oblique on the legs and distal portions of the antennal scapes. Pubescence pale, long, coarse, and sparse, conspicuous on the sides of the head, between the frontal carinae and on the gaster.

Black; mandibles, cheeks, and clypeus cherry-red; antennal funiculi yellow, except the first and last joint, which are black or piceous like the scapes; tarsi and articulations of the thorax, petiole, and legs brown or reddish.

Worker minor. Length 3.5 mm.

Head subtrapezoidal, as broad as long, a little narrower in front than behind, with feebly convex sides and posterior border, only moderately and evenly convex above, with the eyes at the posterior third. Mandibles narrow, with oblique, apparently 4-toothed apical and straight lateral borders. Maxillary palpi much longer than in the major worker. Clypeus broader than long, subtrapezoidal, feebly carinate, with nearly straight, entire anterior border. Frontal area obsolete; frontal groove feeble; frontal carinae short, rather straight, strongly diverging behind. Antennae long, the scapes extending about $\frac{1}{3}$ their length beyond the posterior corners of the head; first funicular joint nearly as long as the second and third together, the second distinctly shorter than the third, which like the fourth and fifth is nearly twice as long as broad. Thorax in profile composed of two subequal hemispherical masses, one formed by the pro- and mesonotum, the other by the meta- and epinotum, meeting at a short, acute, mesoëpinotal incision; the epinotum really without distinct base and declivity, though the lower metasternal border is reflected at the articulation with the petiole. Petiole resembling that of the major worker, but even lower, with its dorsal surface more truncated and flattened.

Sculpture and pilosity much as in the worker major, but the anterior portion of the head not subopaque and punctate, the pubescence on the sides and front of the head replaced by oblique or subappressed, rather abundant hairs and the scapes as abundantly provided with oblique hairs as the legs.

Black; mandibles, anterior border of cheeks and clypeus, the mesopleurae, sides and posteroinferior border of the epinotum, and the tarsi beyond the first joint, red. Funicular joints 3–9 brownish yellow.

Described from three major workers and one minor worker taken on the Rambungan River, Sarawak by Prof. Harrison W. Smith, to whom the species is dedicated. It is very distinct from all the Indomalayan Colobopsis of which I have seen specimens or descriptions. *Type.* M. C . Z. 9,074.

189. Camponotus (incertae sedis) tenuipes (Smith).

Formica tenuipes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 57, ♀.
Camponotus tenuipes Mayr, Verh. Zool. bot. gesellsch. Wien, 1886, **36**, p. 354.

Type-locality: Sarawak, Borneo (A. R. Wallace).

190. Polyrhachis (Polyrhachis) bihamata (Drury).

Formica bihamata Drury, Illustr. nat. hist., 1773, **2**, pl. 38, fig. 7, 8, ☿.
Formica affinis Le Guillou, Ann. Soc. ent. France, 1841, **10**, p. 314, ♀.
Polyrhachis bihamata Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 58, pl. 1, fig. 9.
Polyrhachis affinis Mayr, Verh. Zool. bot. gesellsch. Wien, 1863, **13**, p. 443.

Type-locality: Johanna Island, Comoro Islands.
Sarawak, (Doria and Beccari; A. R. Wallace); Kapouas Basin (Chaper).

Numerous workers from Sarawak River, Kuching, Serambu, Sarawak (H. W. Smith) and Kuching (John Hewitt).

191. Polyrhachis (Polyrhachis) bellicosa Smith.

Polyrhachis bellicosus Smith, Journ. Proc. Linn. soc. London. Zool., 1859, **3**, p. 142, ☿.

Polyrhachis bihamata var. *bellicosa* Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 677.
Polyrhachis bellicosa Mayr, Tijdschr. ent. 1867, **10**, p. 50, ☿.

Type-locality: Aru (A. R. Wallace).
Sarawak (Doria and Beccari; Bedot and Pictet).
Numerous workers from Sadong, Serambu, and Sarawak River, Kuching (H. W. Smith), British North Borneo (E. B. Kershaw), and Kuching (John Hewitt).

192. Polyrhachis (Polyrhachis) ypsilon Emery.

Polyrhachis bihamata Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 58, ☿.
Polyrhachis ypsilon Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 239, ☿.

Type-locality: Borneo.
Fourteen workers from Sadong and Kuching (H. W. Smith).

193. Polyrhachis (Campomyrma) equina Smith.

Polyrhachis equinus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 63, ☿.
Polyrhachis equina Dalla Torre, Cat. Hymenop., 1893, **7**, p. 261.
Polyrhachis biloba Forel, Rev. Suisse zool., 1911, **19**, p. 58, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Haviland).
Examination of a single specimen taken by John Hewitt at Kuching shows that Forel has redescribed Smith's *Polyrhachis equina* as *biloba*.

194. Polyrhachis (Campomyrma) gribodoi Emery.

Polyrhachis gribodoi Emery, Ann. Mus. civ. Genova, 1887, ser. 2, **4**, p. 22, ☿ ♀.

Type-locality: Java.
Sarawak (Doria and Beccari).

195. Polyrhachis (Myrma) relucens (Latreille).

Formica relucens Latreille, Hist. nat. fourmis., 1802, p. 131, ☿, pl. 4, fig. 24.
Polyrhachis relucens Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 59.

Type-locality: East Indies (Riche and La Billardière).
Sarawak (A. R. Wallace).

196. POLYRHACHIS (MYRMA) PRUINOSA Mayr.

Polyrhachis pruinosa Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 142, ☿.

Type-locality: Sarawak, Borneo (Doria and Beccari).

197. POLYRHACHIS (MYRMA) MURINA Emery.

Polyrhachis murina Emery, Rev. Suisse zool., 1893, **1**, p. 198, ☿.

Type-locality: Sarawak, Borneo (Bedot and Pictet).

198. POLYRHACHIS (MYRMA) MAYRI Roger.

Polyrhachis relucens Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 685, ☿ (*nec* Latreille).
Polyrhachis mayri Roger, Verzeich. formicid., 1863, p. 7; Mayr, Tijdschr. ent. 1867, **10**, p. 56, ☿.

Type-locality: Java (Kirsch).
Sarawak (Doria and Beccari); Kapouas Basin (Chaper).
Two workers from Serambu Mt., Sarawak (H. W. Smith).

199. POLYRHACHIS (MYRMA) LYCIDAS Smith.

Polyrhachis lycidas Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **6**, p. 43, ☿, pl. 1, fig. 23; Mayr, Tijdschr. ent., 1867, **10**, p. 31, ☿ ♀.

Type-locality: Celebes.
Borneo (Leyden Mus.).
Two workers from Kuching (John Hewitt).

200. POLYRHACHIS (MYRMA) BECCARII Mayr.

Polyrhachis beccarii Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 141, ☿; Emery, ibid., 1887, ser. 2, **4**, p. 232, ☿.

Type-locality: Sarawak, Borneo (Doria and Beccari).
Two workers from Kuching (John Hewitt).

201. POLYRHACHIS (MYRMA) NIGROPILOSA Mayr.

Polyrhachis nigropilosa Mayr, Ann. Mus. civ. Genova, 1872, **2**, p. 141, ☿; Emery, ibid, 1887, ser. 2, **4**, p. 232, ☿.

Type-locality: Sarawak, Borneo (Doria and Beccari).

Three workers from Serambu Mt., Sarawak and Kuching (H. W. Smith) and British North Borneo (E. B. Kershaw).

201a. POLYRHACHIS (MYRMA) NIGROPILOSA var. CONOPHTHALMA Emery.

Polyrhachis nigropilosa var. *conophthalma* Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 713, ☿.

Type-locality: Sumatra (E. Modigliani).

A single worker from Serambu Mt., Sarawak (H. W. Smith).

202. POLYRHACHIS (MYRMA) SCULPTURATA Smith.

Polyrhachis sculpturatus Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **5**, p. 70, ☿ ♀.

Polyrhachis sculpturata Mayr, Tijdschr. ent., 1867, **10**, p. 59, ☿.

Type-locality: Makassar, Celebes (A. R. Wallace).

Kapouas Basin, Borneo (Chaper).

203. POLYRHACHIS (MYRMA) STRIATA Mayr.

Polyrhachis striatus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 686, ☿, pl. 19, fig. 8.

Polyrhachis striata Mayr, Reise Novara. Zool., **2**, Formicid., 1865, p. 44, ☿, pl. 2, fig. 11.

Type-locality: Java (Novara Expedition).

Sarawak (Doria and Beccari).

A single worker from Kuching (John Hewitt).

204. POLYRHACHIS (MYRMA) SUMATRENSIS Smith.

Polyrhachis sumatrensis Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 65, ♀, pl. 4, fig. 43; Forel, Sitzb. K. bayr. akad. wiss. Math. phys. klasse, 1911, p. 296.

Type-locality: Sumatra.
Sarawak (Munich Mus.).

205. Polyrhachis (Myrma) villipes Smith.

Polyrhachis villipes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 61, ☿; Mayr, Tijdschr. ent., 1867, **10**, p. 58, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Sarawak (Doria and Beccari; Haviland).

Two workers and a female from Kuching (John Hewitt) and a worker from the same locality (H. W. Smith).

206. Polyrhachis (Myrma) vindex Smith.

Polyrhachis vindex Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 64, ☿.

Type-locality: Sarawak, Borneo (A. R. Wallace).
Worker. Length: 5–6 mm.

Head broadly oval, a little longer than broad, and a little broader behind than in front, nearly as high in the region of the frontal carinae as long. Eyes distinctly behind the middle of the sides, moderately large and convex. Mandibles with feebly convex external and oblique, coarsely 4-toothed apical border. Clypeus subcarinate, its anterior border feebly and sinuately emarginate in the middle and on each side. Frontal area distinct, triangular; frontal carinae closely approximated, erect, very close together anteriorly. Antennae long; scapes slender, reaching about $\frac{2}{5}$ their length beyond the occiput. Thorax short, only a little longer than its greatest height, the sides flat, the dorsum evenly convex and rounded, its sides acutely marginate, the margin incised at the distinct promesonotal and at the nearly obsolete mesoëpinotal suture. Pronotum, excluding the neck, nearly twice as broad as long, its anterior corners produced as flattened, acute spines which are nearly twice as long as broad at their bases, and directed forward and very slightly outward. Mesonotum transversely oblong, nearly as broad as the pronotum and nearly four times as broad as long. Base of epinotum trapezoidal, somewhat less than twice as broad as long, with straight sides and posterior border, the latter strongly marginate, with a small, acute, upturned tooth at each corner, the declivity abrupt, concave and narrowed below, as long as the base and marginate on the sides. Petiole lenticular, as broad as the anterior border of the epinotum, in profile convex anteriorly and posteriorly, with a sharp superior border, which seen from behind is evenly arcuate and entire, with a small, rather acute, triangular tooth on each side. Below the teeth the sides are straight and rapidly converge. Gaster subglobose, with very large first segment, strongly and concavely truncated in front. Legs long and stout, tibiae cylindrical, constricted at the base, without bristles on their flexor surfaces.

Subopaque; mandibles finely and evenly striated, with minute, scattered punctures; clypeus finely and densely punctate; upper surface of head, dorsum and sides of thorax evenly and rather finely longitudinally rugose with indistinctly punctate interrugal spaces; sides of head finely and somewhat irregularly rugulose-punctate; gula smooth and shining; declivity of epinotum finely, transversely rugulose; petiole and gaster lustrous, very finely and indistinctly punctate.

Hairs very sparse, whitish, erect, confined to the head and tips of the gaster. Pubescence whitish, indistinct on the head; longer and more abundant on the pleurae; very fine and dense, producing a pruinose appearance on the thoracic dorsum, petiole, and gaster, less apparent on the legs.

Black; palpi reddish; legs variable in color; in some specimens black throughout, in others with the femora and tibiae red or reddish yellow and the knees, coxae, and tarsi black.

Eight workers; three from Kuching (John Hewitt "nesting at base of an epiphyte between intertwining roots"), one from Kuching and one from Serambu Mt. (H. W. Smith), two from Bongo Mt. (Hewitt and Brooks) and one from Mt. Matang, West Sarawak (G. E. Bryant).

I have redescribed this form in detail because it seems certain that it is Smith's *P. vindex,* which has not been recognized up to the present time. The species is evidently very close to Smith's *inermis* and *orsyllus,* especially to the latter, but both of these forms were described later and would therefore be only subspecies or synonyms of *vindex.*

*207a. POLYRHACHIS (HEMIOPTICA) ACULEATA Mayr subsp. CYBELE, subsp. nov.

Worker. Length 6–6.5 mm.

Differing from the typical form in its somewhat larger size, broader head, and decidedly larger and higher petiole, with its two spines a little shorter and the transverse margin between them more arcuate and sharper. The eyes are a little larger and distinctly less truncated laterally and less conical and more hemispherical when seen from the front. The erect, pale hairs on the body are distinctly less abundant than in the typical *aculeata* and the legs are entirely black.

Described from four specimens from Kuching (John Hewitt). *Type.*—M. C. Z. 9,076.

*208a. POLYRHACHIS (MYRMOTHRINAX) THRINAX Roger var. JAVANICA Mayr.

Polyrhachis thrinax var. *javanica* Mayr, Tijdschr. ent., 1867, **10**, p. 20, ☿.

Type-locality: Java (Mus. Holm.).

Three workers from Kuching (John Hewitt).

209. POLYRHACHIS (MYRMOTHRINAX) AEQUICUSPIS, nom. nov.

Polyrhachis constructor Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 68, ♀, pl. 4, fig. 23 (*nec P. constructor* Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 60).

Type-locality: Sarawak, Borneo (Saunders Coll.).

It seems not to have been noticed that Smith gave the name *constructor* to two very different species of Polyrhachis. In 1857 he described a *P. constructor* from a female specimen taken by A. R. Wallace at Sarawak. This specimen measured 3½ lines and had the petiole "quadrate, with two very stout, short, curved spines above" and the body covered with "short, silky, ashy pile, most apparent on the abdomen." In 1858 he gave the same name to a female from the same locality but from the W. W. Saunders Collection, measuring 4½ lines, with the "node of the petiole incrassate and with three stout, short, acute spines." The figure accompanying this description shows that he had before him a species of Myrmothrinax, with subequal petiolar spines, possibly the form afterwards called *thrinax* var. *javanica* by Mayr. It therefore becomes necessary to change the name of the second *constructor*. The first will have to be consigned to the species of Polyrhachis *incertae sedis* for the present (*vide infra* p. 137).

*210. POLYRHACHIS (MYRMOTHRINAX) TRIAENA, sp. nov.

Worker. Length 6.5–7 mm.

Head a little longer than broad, a little broader behind than in front, with evenly rounded and convex occipital border and straight sides; very convex dorsally in the frontal region. Eyes large and convex, broadly elliptical, their anterior orbits at the median transverse diameter of the head. Mandibles very convex, with five large, subequal teeth. Clypeus carinate, broader than long, its anterior border entire, evenly rounded and slightly projecting. Frontal area distinct, triangular; frontal groove narrow but distinct; frontal carinae rather approximated, prominent, sinuous, as near together behind as in front. Antennae long; scapes extending more than half their length beyond the occipital border, the basal funicular joints about 2¼ times as long as broad. Thorax slender, its dorsal and lateral surfaces flattened, the former strongly marginate on all sides, except at the neck. Promesonotal and mesoëpinotal sutures distinct, but not incised where they meet the lateral marginations. Dorsum of pronotum as broad as long, with two flat, blunt teeth anteriorly, as long as broad at their bases, directed outwards; dorsum of mesonotum trapezoidal, about 1¼ times as long as broad, with straight sides, converging posteriorly. Base of epinotum regularly oblong, twice as long as broad, its posterior angles forming two small erect teeth, as large as those on the pronotum but more acute; epinotal declivity shorter than the base, sloping and concave. Petiole from above 1¼ times as long as broad, broader in front than behind, bearing above in the middle a long, straight, backwardly directed spine, nearly as long as the greatest height of the remainder of the petiole, and on each side a triangular tooth, only a little longer than broad at the base and somewhat blunter than the median spine. Gaster a little larger than the head, oval, broad in front. Legs long; tibiae cylindrical, distinctly constricted at the base, without a row of bristles on their flexor surfaces.

Mandibles slightly shining, very finely striated and finely and sparsely punctate; clypeus, head, thorax, and petiole densely and evenly punctate. Gaster and legs very finely and superficially shagreened, the former shining, the latter lustrous.

Hairs very few, short, obtuse, yellowish, confined to the clypeus, mandibles, and tip of the gaster; pubescence extremely fine and dilute, visible only on the antennae and tibiae.

Brownish ferruginous; scapes, legs, and gaster a little paler than the head, thorax, and petiole.

Female (deälated). Length nearly 10 mm.

Resembling the worker in the shape of the head and petiole. Thorax elongate-elliptical, nearly 2½ times as long as broad, narrower than the head; meso- and epinotum not marginate on the sides, the former as broad as long, convex in front, flattened behind; the latter with subequal base and declivity, the base slightly convex and not separated from the sloping, concave declivity by a transverse ridge as in the worker; epinotal teeth stout, short, and blunt, directed upward. Pronotum with the blunt, triangular teeth at the anterior corners not connected by a distinct transverse carina. Median spine of the petiole of rather uniform thickness, with blunt tip.

Sculpture resembling that of the worker, but the head, thorax, and petiole delicately reticulate-rugose as well as finely punctate.

Black; tip of last funicular joint yellowish; gaster with a slightly reddish tint.

Described from two workers and a female taken by Mr. John Hewitt at Kuching.

Of the various species of Myrmothrinax, namely *thrinax* Roger, *textor* Smith, *aequicuspis* Wheeler, *dahli* Forel and *frauenfeldi* Mayr, this species seems to be most closely related to the last. The worker *triaena*, however, is smaller, not black and has the sides of the thorax sharply marginate, whereas Mayr says of *frauenfeldi* that it has the "thorax sine marginibus acutis." The Bornean form is not unlike *dahli* in the general shape of the thorax, but the pronotal teeth of the former are longer, the epinotal teeth much shorter, the sculpture, color, and size are different and the basal funicular joints are shorter. *P. triaena* occurs also in Java as I possess a deälated female from that island received from Staudinger under the name *frauenfeldi*.

211. POLYRHACHIS (CHARIOMYRMA) ARCUATA (Le Guillou).

Formica arcuata Le Guillou, Ann. Soc. ent. France, 1841, **10**, p. 315, ☿ ♀.
Polyrhachis latifrons Roger, Berlin ent. zeitschr. 1863, **7**, p. 155, ☿.
Polyrhachis modiglianii Emery, Ann. Mus. civ. Genova, 1888, ser. 2, **5**, p. 529, ☿ ♀, pl. 9, fig. 1.
Polyrhachis arcuata Forel, Mitth. Zool. mus. Berlin, 1901, **2**, p. 32.

Type-locality: Borneo (Voyage of the "Astrolabe" and "Zelée").

A single deälated female from Bongo Mt., Sarawak (Hewitt and Brooks).

212. POLYRHACHIS (MYRMHOPLA) ARMATA (Le Guillou).

Formica armata Le Guillou, Ann. Soc. ent. France, 1841, **10**, p. 313, ♂.
Polyrhachis armata Mayr, Tijdschr. ent., 1867, **10**, p. 46, ☿.
Polyrhachis defensus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 59, ☿.
Polyrhachis pandarus Smith, ibid, p. 62, ☿.

Type-locality: Samboangan, Philippines (Voyage of the "Astrolabe" and "Zelée").

Sarawak (Doria and Beccari; A. R. Wallace); Hayvep (Winkler).

Numerous workers and females from Kuching (John Hewitt) and Kuching, Matang, and Serambu Mts. (H. W. Smith) and British North Borneo (E. B. Kershaw). Nearly all of these specimens have the gaster ferruginous instead of black.

213. POLYRHACHIS (MYRMHOPLA) LUGENS Mayr.

Polyrhachis lugens Mayr, Tijdschr. ent., 1867, **10**, p. 31, ♀.

Type-locality: Borneo (Leyden Museum).

*214. POLYRHACHIS (MYRMHOPLA) PRESSA Mayr.

Polyrhachis pressus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 681, ☿ ♀.
Polyrhachis pressa Mayr, Reise Novara. Zool., **2**. Formicid., 1865, p. 39, ☿ ♀, pl. 1, fig. 5.

Type-locality: Batavia, Java (Novara Expedition).
A single worker from Kuching (John Hewitt).

215. POLYRHACHIS (MYRMHOPLA) ABDOMINALIS Smith.

Polyrhachis abdominalis Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 63, ☿.
Polyrhachis phyllophilus Smith, Journ. Proc. Linn. soc. London. Zool. Suppl., 1860, **4**, p. 69, ☿.
Polyrhachis phyllophila Mayr, Tijdschr. ent., 1867, **10**, p. 47, ☿.

Type-locality: Burmah.
Sarawak (Doria and Beccari); Kapouas Basin (Chaper).
Two workers from British North Borneo (E. B. Kershaw) and one from Serambu Mt., Sarawak (H. W. Smith).

216. POLYRHACHIS (MYRMHOPLA) RUBIGINOSA (Le Guillou).

Formica rubiginosa Le Guillou, Ann. Soc. ent. France, 1841, **10**, p. 316, ☿.
Polyrhachis rubiginosa Emery in Dalla Torre, Cat. Hymenop., 1893, **7**, p. 268.

Type-locality: Borneo (Voyage of the "Astrolabe" and "Zelée").

*217. POLYRHACHIS (MYRMHOPLA) RUGIFRONS Smith.

Polyrhachis rugifrons Smith, Journ. Proc. Linn. soc. London. Zool., 1861, **5**, p. 70, ♀; Mayr, Tijdschr. ent., 1867, **10**, p. 43, ☿.

Type-locality: Makassar, Celebes (A. R. Wallace).
A single worker from Serambu Mt., Sarawak (H. W. Smith).

*218. POLYRHACHIS (MYRMHOPLA) FURCATA Smith.

Polyrhachis furcatus Smith, Cat. Hymenop. Brit. mus. 1858, **6**, p. 64, ☿, pl. 4, fig. 20.

Polyrhachis furcata Forel, Journ. Asiat. soc. Bengal, 1886, **55**, p. 241, ☿; Emery, Ann. Mus. civ. Genova, 1889, ser. 2, **7**, p. 518, ☿ ♀.

Type-locality: Burmah.

A single deälated female from the Rambungan River, Sarawak (H. W. Smith). As Emery has observed, the petiolar spines of the female are not hooked as in the worker, but merely curved.

219. POLYRHACHIS (MYRMHOPLA) CHALYBEA Smith.

Polyrhachis chalybea Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 61, ☿.

Type-locality: Singapore (A. R. Wallace).

Sarawak (Doria and Beccari); Kapouas Basin (Chaper).

A single worker from Kuching (John Hewitt).

220. POLYRHACHIS (MYRMHOPLA) ARGENTEA Mayr.

Polyrhachis argenteus Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 682, ☿.

Polyrhachis argentea Mayr, Reise Novara. Zool., **2**. Formicid., 1865, p. 40, ☿, pl. 2, fig. 7.

Polyrhachis acasta Forel, Journ. Asiat. soc. Bengal, 1886, **55**, p. 241, ☿; Dalla Torre, Cat. Hymenop., 1893, **7**, p. 257.

Type-locality: Manila, Philippine Islands (Novara Expedition).

Sarawak (Bedot and Pictet).

221. POLYRHACHIS (MYRMHOPLA) BICOLOR Smith.

Polyrhachis bicolor Smith, Cat. Hymenop. Brit. mus. 1858, **6**, p. 65, ♀; Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 681, ♀, pl. 19, fig. 5.

Type-locality: Burmah.

Sarawak (Doria and Beccari; Bedot and Pictet). Tandjong, S. E. Borneo (Fritz Suck).

A few workers, females, and males from Kuching (John Hewitt).

221a. POLYRHACHIS (MYRMHOPLA) BICOLOR Smith var. AURINASIS Forel.

Polyrhachis bicolor var. *aurinasis* Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 77, ☿.

Type-locality: Sarawak, Borneo (Haviland).

222. POLYRHACHIS (MYRMHOPLA) CEPHALOTES Emery.

Polyrhachis cephalotes Emery, Rev. Suisse zool., 1893, **1**, p. 199, ☿, pl. 8, fig. 6; Forel, Rev. Suisse zool., 1913, **21**, p. 665, ☿ ♀ ♂.

Type-locality: Deli, Sumatra (Bedot and Pictet).
Balik Papan, Borneo (Kampmeinert).

223. POLYRHACHIS (MYRMHOPLA) DIVES Smith.

Polyrhachis dives Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 64, ☿.
Polyrhachis acantha Smith, ibid, Suppl., 1860, **4**, p. 98, ☿, pl. 1, fig. 16.

Type-locality: Singapore (A. R. Wallace).
Borneo (Leyden Museum).

*224. POLYRHACHIS (MYRMHOPLA) TIBIALIS Smith.

Polyrhachis tibialis Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 63, ☿.

Type-locality: Burmah.
A single worker from Kuching (John Hewitt).

225. POLYRHACHIS (MYRMHOPLA) DIOTIMA Forel.

Polyrhachis diotima Forel, Rev. Suisse zool., 1911, **19**, p. 60, ☿.

Type-locality: Hayvep, Borneo (Winkler).

226. POLYRHACHIS (MYRMHOPLA) ASPASIA Forel.

Polyrhachis aspasia Forel, Rev. Suisse zool., 1911, **19**, p. 59, ☿.

Type-locality: Sarawak, Borneo (Haviland).

*227. POLYRHACHIS (MYRMHOPLA) DAPHNE, sp. nov.

Worker. Length: 5.5–6 mm.

Head a little longer than broad, a little broader at the eyes than at the anterior corners, semicircularly rounded behind, with rather straight sides and cheeks; in profile very convex in the region of the frontal carinae, with feebly convex gular surface. Eyes large and convex, their anterior orbits at the median transverse diameter of the head. Palpi long and slender. Mandibles moderately convex, with four stout, subequal teeth. Clypeus semicircular, convex, ecarinate; its anterior border very feebly sinuate on each side of the middle which does not project as a lobe. Clypeal fossa very pronounced. Frontal area indistinct, triangular. Frontal carinae approximated, sinuate, erect, not further apart behind than in front. Antennae long, their scapes extending fully half their length beyond the occipital border of the head. Thorax subcylindrical, narrower than the head, a little broader through the posterior part of the pronotum than through the meso- and epinotum which are of equal width; pro- and mesoëpinotal sutures very distinct and strongly impressed. Pronotum, excluding the neck, a little broader than long, rounded on the sides, with two stout, straight, acute spines which are twice as long as the width of their bases and directed forward and outward. Mesonotum as long as broad, its anterior outline semicircular, its lateral and posterior borders straight, the sides not marginate. Epinotum compressed above, the base horizontal and slightly concave, oblong, strongly marginate on the sides, the marginations continued into the spines which are stout, straight, acute, twice as long as those on the pronotum and as long as the base of the epinotum, laterally compressed, and directed backward and very slightly upward. The epinotal declivity is abrupt, slightly concave in profile, not marginate on the sides, with large, prominent stigmata. Petiole subcuboidal with a denticle on each side below near the anterior border and above with two stout, compressed, curved spines, a little longer than those on the epinotum and directed outward and backward. The distance between their tips is less than half the diameter of the first gastric segment. Gaster large, broadly elliptical, less than half of it formed by the first segment, slightly flattened dorsoventrally, convex but not truncated in front. Legs long; tibiae cylindrical, slightly constricted at the base, without bristles on their flexor surfaces.

Mandibles and clypeus smooth and shining, the former minutely and sparsely punctate; head shining above, subopaque on the sides; shagreened, the vertex and sides of the front sparsely punctate. Thorax and petiole opaque; sides of the former densely and evenly punctate, the dorsum very finely punctate-rugulose, the rugules on the mesonotum obscurely concentric, the base of the epinotum, especially behind, smooth and shining. Petiole indistinctly punctate, slightly shining between the insertions of the spines. Gaster shining, very finely and superficially shagreened or aciculate, with small, sparse punctures; legs more opaque and more coarsely shagreened.

Hairs yellow, erect; present only on the venter, tip of gaster, mandibles, and anterior border of the clypeus. Pubescence yellow, very short, sparse, and appressed, distinct on the sides of the head, on the legs and gaster.

Brownish yellow; mandibles reddish, with dark brown teeth; scapes, except their tips, a median line on the clypeus, the upper surface of the head and sides of the front, a large spot on the pronotum, the mesonotum, epinotum, petiole, and basal half of first gastric segment, brown; epinotal and petiolar spines, tarsi, and constricted bases of the tibiae somewhat darker.

Described from two specimens taken by Prof. Harrison W. Smith on Matang Mt., near Kuching. *Type.*— M. C. Z. 9,075.

I can find no description of this beautiful and striking species.

*228. Polyrhachis (Myrmhopla) personata, sp. nov.

Worker. Length nearly 5 mm.

Head oval, a little longer than broad, slightly narrowed in front and behind, with rounded sides, convex above in the region of the frontal carinae, the lower surface in profile convex in the middle, owing to a peculiar condition of the occipital margin, which descends on each side of the narrowed gula as a prominent ridge or fold and extends all the way to the anterior corner of the head, with a blunt angle about half way between the neck and the mandible. The ant therefore has the appearance of wearing a mask, the border of which stands off on the sides and below from the neck. Eyes moderately large and convex, broadly elliptical, with impressed orbits, at the middle of the sides of the head. Mandibles feebly convex, 5-toothed. Clypeus moderately convex, subcarinate behind, its border forming a short lobe, straight in the middle and rounded on each side. Frontal area obsolete. Frontal carinae approximated, strongly sinuate and bluntly angular in the middle, a little further apart behind than in front. Antennae long, the scapes extending about $\frac{1}{5}$ their length beyond the occipital border. Thorax subcylindrical, narrower than the head, about twice as long as broad, slightly broader through the pronotum than elsewhere; pronotum, excluding the neck, as long as broad, rounded and rather convex above, anteriorly with a pair of straight, slender, acute spines, directed outward, upward, and slightly forward. Promesonotal suture distinct and slightly impressed; mesoëpinotal suture obsolete. Mesonotum broader than long, transversely rounded, its dorsal outline straight in profile. Epinotum short, the base much shorter than the straight, abrupt declivity, armed with two slender, acute spines about half again as long as those of the pronotum, directed outward, backward, and upward, their tips very feebly recurved. Petiole stout, with convex anterior and posterior surfaces, bearing above a pair of long, stout, curved, acute spines. These are much longer and stouter than those on the epinotum and form a semicircle, clasping the base of the gaster. The median dorsal border of the petiole between their bases bears two small acute teeth. Gaster subglobose, as broad as long, slightly flattened, the first segment forming about $\frac{2}{3}$ of its surface, truncated in front. Legs moderately long; tibiae cylindrical, constricted at the base, without bristles on their flexor surfaces.

Gaster and gula smooth and shining; remainder of body and the appendages subopaque. Mandibles very finely striated and sparsely punctate; head, thorax, and petiole densely punctate-rugulose, the rugules coarser and reticulate on the dorsal surface of the head; the spines of the epinotum and petiole very finely shagreened, like the antennal scapes and legs.

Hairs whitish, erect; present only on the venter, tip of gaster, clypeal border, and mandibles. Pubescence pale, very fine and dilute, visible only on the tibiae, antennal funiculi, and sides of the gaster.

Black; palpi and spurs of the tibiae red.

Described from a single specimen taken by Mr. G. E. Bryant on Mt. Matang, West Sarawak and sent me by Mr. Horace Donisthorpe. This species belongs to the *dives* group but is very distinct in the shape of the head, thorax, and petiole.

*229. POLYRHACHIS (MYRMHOPLA) ATROVIRENS Emery.

Polyrhachis atrovirens Emery, Ann. Mus. civ. Genova, 1900, ser. 2, **20**, p. 718, ☿, fig. 16a.

Type-locality: Bua Bua, Engana (E. Modigliani).

A single worker from Sadong, Sarawak (H. W. Smith).

*230. POLYRHACHIS (MYRMHOPLA) OEDACANTHA, sp. nov.

Worker. Length 4 mm.

Related to *P. hippomanes* Smith and *atrovirens* Emery. Head elliptical, longer than broad, semicircularly rounded behind with feebly convex sides and equally convex dorsal and gular surfaces. Eyes moderately convex, their anterior orbits at the median transverse diameter of the head. Mandibles with rather rounded external borders, the apical borders with 5 subequal teeth. Clypeus carinate at the base, its anterior border broadly rounded and somewhat crenulate. Frontal area distinct, triangular. Frontal carinae approximated, sinuous, a little further apart behind than in front; frontal groove absent. Antennae long and slender, their scapes extending fully $\frac{2}{5}$ their length beyond the posterior border of the head. Thorax from above elongate trapezoidal, broadest through the humeri, evenly, longitudinally, and transversely rounded and convex above, with distinct promesonotal and mesoëpinotal sutures. Pronotum about $1\frac{1}{2}$ times as broad as long, its anterior corners produced as flattened, triangular and slightly upturned teeth. Mesonotum of the same length as the pronotum; epinotum very short, without distinct base, but sloping abruptly from the mesoëpinotal suture which lies just in front of the spines. These are long, stout, and acute, as long as the declivity, widely separated and curved at their bases, with slightly sinuous tips, directed backward, upward, and outward. Petiole in profile with straight, not angulate, anterior and slightly convex posterior surface, armed above with a pair of stout spines, longer and stouter than those of the epinotum, constricted at the base and distinctly swollen in the middle, curved and tapering, directed outward and backward around the base of the gaster. The distance between their tips is a little less than the greatest diameter of the gaster, which is subglobose, distinctly broader than long, with $\frac{2}{3}$ of its surface formed by the first segment. Legs moderately long, tibiae cylindrical, strongly constricted at their bases, without bristles on their flexor surfaces.

Head, thorax, petiole, and legs subopaque; mandibles very finely striated and sparsely punctate; head, thorax, and petiole densely and uniformly punctate, thoracic dorsum also with scattered, shallower punctures; epinotal and petiolar spines longitudinally rugulose. Gaster shining, more finely and more superficially punctate than the head and thorax. Legs finely and sharply shagreened.

Hairs and pubescence whitish, the former only on the venter, tip of gaster, clypeus, and mandibles, the latter very fine, distinct only on the gaster, which has a slightly pruinose appearance.

Black; head, thorax, and petiole with indistinct purplish metallic reflections, more greenish on the occiput. Palpi, tibiae, femora, and middle and hind coxae red, tips of femora and constricted bases of the tibiae more or less infuscated.

Described from a single specimen taken by Mr. John Hewitt at Kuching.

This species, though closely related to *P. hippomanes, paromalus, mucronata,* and *atrovirens,* is easily distinguished by the robust, somewhat fusiform epinotal spines. It is perhaps merely a subspecies of *hippomanes,* although the petiole does not agree with Smith's figure of the type from Celebes. It is certainly very different from the subsp. *ceylonensis* Emery, represented in my collection by a couple of specimens received from Professor Forel.

231. POLYRHACHIS (CYRTOMYRMA) RASTELLATA (Latreille).

Formica rastellata Latreille, Hist. nat. fourmis, 1802, p. 130, ♀.
Polyrhachis rastellata Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 59.

Type-locality: East Indies (Riche).
Sarawak (Doria and Beccari).

232. Polyrhachis (Cyrtomyrma) laevissima Smith.

Polyrhachis laevissimus Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 64, ☿, pl. 4, fig. 42.

Polyrhachis globularia Mayr, Tijdschr. ent., 1867, **10**, p. 41, ☿.

Polyrhachis laevissima Mayr, Verh. Zool. bot. gesellsch. Wien, 1878, **28**, p. 651, ♀.

Polyrhachis levissima Dalla Torre, Cat. Hymenop., 1893, **7**, p. 264.

Type-locality: Burmah.
Kapouas Basin, Borneo (Chaper).

233. Polyrhachis (incertae sedis) castaneiventris Smith.

Polyrhachis castaneiventris Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 67, ♀.

Type-locality: Sarawak, Borneo (A. R. Wallace).

234. Polyrhachis (incertae sedis) nitida Smith.

Polyrhachis nitidus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 61, ♀.

Polyrhachis nitida Dalla Torre, Cat. Hymenop. 1893, **7**, p. 266.

Type-locality: Sarawak, Borneo (A. R. Wallace).

235. Polyrhachis (incertae sedis) ruficornis Smith.

Polyrhachis ruficornis Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 60, ♀.

Type-locality: Sarawak, Borneo (A. R. Wallace).
This is probably the female of *P. bicolor* Smith.

236. Polyrhachis (incertae sedis) constructor Smith.

Polyrhachis constructor Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 60, ♀ (*nec P. constructor* Smith, Cat. Hymenop. Brit. mus., 1858, **6**, p. 68).

Type-locality: Sarawak, Borneo (A. R. Wallace).

237. ECHINOPLA LINEATA Mayr.

Echinopla lineata Mayr, Verh. Zool. bot. gesellsch. Wien, 1862, **12**, p. 689, ☿.

Type-locality: Singapore.
Sarawak (Doria and Beccari).

238. ECHINOPLA MELANARCTOS Smith.

Echinopla melanarctos Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 79, ☿, pl. 25, fig. 29.

Type-locality: Singapore (A. R. Wallace).
Sarawak (Doria and Beccari; Haviland).

239. ECHINOPLA PALLIPES Smith.

Echinopla pallipes Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 80, ☿.
Echinopla pallidipes Dalla Torre, Cat. Hymenop., 1893, **7**, p. 272.

Type-locality: Sarawak, Borneo (A. R. Wallace).
A single worker from Kuching (John Hewitt).

240. ECHINOPLA RUGOSA Ern. André.

Echinopla rugosa Ern. André, Mém. Soc. zool. France, 1892, **5**, p. 47, ☿.

Type-locality: Kapouas Basin, Borneo (Chaper).

241. ECHINOPLA STRIATA Smith.

Echinopla striata Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 80, ☿.

Type-locality: Malacca (A. R. Wallace).
Sarawak (Doria and Beccari).
Three workers from Serambu Mt., Sarawak (H. W. Smith).

242. ECHINOPLA SUCKI Forel.

Echinopla sucki Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 75, ☿.

Type-locality: Tandjong, N. E. Borneo (Fritz Suck).
Three workers from Kuching (John Hewitt).

243. ECHINOPLA TRITSCHLERI Forel.

Echinopla tritschleri Forel, Mitth. Naturh. mus. Hamburg, 1901, **18**, p. 74, ☿ ♀.

Type-locality: Indrapura, Sumatra (Tritschler).
Tandjong, S. E. Borneo (Fritz Suck).

BORNEAN SPECIES INCERTAE SEDIS.

244. CERAPACHYS OCULATUS Smith.

Cerapachys oculatus Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 74, ♂.

Type-locality: Sarawak, Borneo (A. R. Wallace).

245. PONERA APICALIS Smith.

Ponera apicalis Smith, Journ. Proc. Linn. soc. London. Zool. 1857, **2**, p. 66, ♀.

Type-locality: Sarawak, Borneo (A. R. Wallace).

246. PONERA POMPILOIDES Smith.

Ponera pompiloides Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 69, ♂.

Type-locality: Sarawak, Borneo (A. R. Wallace).

247. PONERA VIDUA Smith.

Ponera vidua Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 68, ♂.

Type-locality: Sarawak, Borneo (A. R. Wallace).

248. ATTA PENETRANS Smith.

Atta penetrans Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 77, ♀.
Aphaenogaster penetrans Dalla Torre, Cat. Hymenop., 1893, **7**, p. 104.

Type-locality: Sarawak, Borneo (A. R. Wallace).

249. ATTA CINGULATA Smith.

Atta cingulata Smith, Journ. Proc. Linn. soc. London. Zool., 1857, **2**, p. 77, ☿.
Aphaenogaster cingulata Dalla Torre, Cat. Hymenop., 1893, **7**, p. 102.

Type-locality: Sarawak, Borneo (A. R. Wallace).

POSTSCRIPT.

A series of specimens, which Prof. C. F. Baker of Manila, P. I. collected at Sandakan, Borneo and sent me too late to be included in the foregoing revision, comprises several interesting and four new species.

1. CERAPACHYS ANTENNATUS Smith. (*Ante* p. 45).

Male. Length about 7 mm.

Long and slender. Head, including the eyes, as broad as long, the eyes large, fully ⅓ as long as the sides of the head and situated a little in front of its middle. Mandibles shaped as in the worker, their apical borders well-developed and finely denticulate. Clypeus indistinctly carinate behind, its anterior border broadly rounded and entire. Antennae long and stout, scapes somewhat longer than the three basal funicular joints together; first funicular joint as long as broad, the second broader than long, the remaining joints longer than broad, gradually increasing in length to the tip. Thorax through the wing-insertions as broad as the head through the eyes, mesonotum feebly convex, with pronounced Mayrian furrows. Epinotum in profile angular, with subequal base and declivity, the latter flat, seen from behind subcircular, strongly marginate both above and on the sides. Petiole subcylindrical, 1⅔ times as long as broad, sharply truncated and marginate in front. Postpetiole broader than the petiole, broader behind than in front, also 1⅔ times as long as broad, with evenly convex dorsal, lateral, and ventral surfaces.

Gaster very long and narrow, broadest in the middle, the basal half formed by the first segment. Genital appendages small and retracted. Legs rather long and slender.

Shining; mandibles very sparsely, coarsely, and irregularly punctate. Clypeus feebly striolate. Head finely and rather regularly longitudinally rugose on the front, irregularly punctate-rugulose behind. Thorax coarsely and transversely foveolate along the sutures and Mayrian furrows and coarsely and sparsely foveolate on the surfaces of the sclerites. Pronotum longitudinally rugose. Base of epinotum coarsely and vermiculately rugose, the declivity finely and densely punctate-rugulose. Petiole above with a few strong, undulating longitudinal rugae, becoming more reticulate on the sides. Postpetiole, gaster, and legs smooth, with minute, sparse, piligerous punctures.

Hairs as in the worker, and most abundant on the apical portion of the gaster.

Black; mandibles, genitalia, and tips of tarsi reddish. Wings grayish hyaline, with large black pterostigma and dark brown veins.

Described from a single specimen, which must, I believe, represent the hitherto unknown male of *C. antennatus* though the sculpture of the head, thorax, and petiole is very different from that of the worker.

*2. Myopopone castanea Smith ♀.

3. Platythyrea pusilla Emery ♀ (*Ante*, p. 50).

*4. Bothroponera sandakana, sp. nov.

Female. Length about 14 mm.; wings 11 mm.

Allied to *rufipes* Jerdon and *insularis* Emery. Head, excluding the mandibles, broader than long and considerably broader behind than in front, with broadly excavated posterior border and nearly straight sides. Posterior orbits of the moderately large and convex eyes at the median transverse diameter of the head. Mandibles large and rather convex above, not flattened as in *rufipes*, their apical borders finely and rather evenly serrate. Clypeus short, strongly carinate, truncated anteriorly in the middle; the anterior border entire, straight, and transverse. Antennae short and stout, scapes reaching nearly to the middle of the occipital border, all the funicular joints, except the first and last, distinctly broader than long. Thorax through the wing-insertions a little narrower than the head. Epinotum sharply angular in profile, the base feebly convex and distinctly shorter than the concave, sloping declivity, which has a marked, crenulate border, both above and on the sides. Petiole higher than thick, as thick above as below, truncated in front and behind, convex above and on the sides, the posterior surface slightly concave but with its superior border merely sub marginate and not denticulate. Gaster and legs of the usual form.

Mandibles shining, very coarsely and sparsely punctate, with a few coarse rugae near the base. Remainder of body subopaque, densely punctate; head, thorax, and petiole also covered with sparse but rather regular foveolae, which are more pronounced on the posterior portion of the head, sides of thorax, and on the petiole. Epinotal declivity rather shining, very minutely punctate. Postpetiole and first gastric segment longitudinally but much less sharply costate than in *rufipes*, the spaces between the costae with shallow foveae having sharper anterior margins. These foveae become much more distinct on the sides of the segments. Legs with sparse piligerous punctures.

Hairs and pubescence golden, abundant and rather long, the pubescence appressed on the head, gaster, and appendages, more oblique on the thoracic dorsum, nearly absent on the pleurae. Hairs longest on the abdomen, especially on the apical segments.

Dark brown; mandibles blackish; legs, including the coxae, posterior borders of gastric segments, wing-insertions, epinotum and petiole reddish. Wings rather heavily infuscated, with blackish stigma and brown veins.

A single specimen. I describe this large ant with some reluctance. It is certainly not a form of *rufipes* or of *insularis*, judging from Emery's very brief description of the worker of the latter species. Professor Baker sent me from Singapore a female specimen which evidently represents a variety of *insularis*, and I possess a worker from Ceylon labeled "*insularis*" by Forel. Though these specimens have the mandibles much like those of *sandakana* in being shining, convex, and without the fine, longitudinal striae of *rufipes*, the petiole has a sharp denticulate postero-superior border. According to Emery, the petiole is also costate in the typical *insularis* and this is the case in my Ceylonese specimen.

5. BOTHROPONERA TRIDENTATA (Smith) ☿ ♂ (*Ante*, p. 55).

Male. Length nearly 10 mm.

Head through the very large, convex, and reniform eyes broader than long, flat above, with evenly rounded posterior border and very short cheeks, the eyes occupying nearly the whole of the sides of the head. Ocelli large and prominent. Mandibles small, flat, edentate. Palpi very long, the labial pair 3-, the maxillary pair 5-jointed, the three terminal joints of the latter long and attenuated. Clypeus feebly convex, ecarinate, with straight, entire anterior border. Antennae very long and slender, filiform; scape short, only twice as long as broad, the first funicular joint as broad as long, the remaining joints cylindrical, gradually diminishing in length towards the tip. Thorax somewhat broader through the wing-insertions than the head. Pronotum transverse, truncated in front; mesonotum as long as broad, feebly convex above, without

Mayrian furrows; scutellum very convex; epinotum in profile strongly angular, both the base and declivity concave, the former shorter than the latter, the two surfaces separated by a pronounced, subcircular margination or carina. Petiole like that of the worker but with the three blunt teeth on the posterosuperior border much less prominent, the ventral surface with two strong teeth, the anterior directed downward and forward, the posterior somewhat longer and more slender, directed downward and backward. Postpetiole broader than long, evenly and convexly rounded in front, strongly marked off from the broader and very short gaster, the last segment of which terminates in a long, stout, downwardly curved spine. Genitalia deeply retracted. Legs slender.

Subopaque; postpetiole, gaster, and legs shining. Head very finely punctate; thorax densely punctate, the pro- and mesonotum and mesopleurae also with indistinct, scattered foveolae. Scutellum and epinotum irregularly rugose, the declivity of the latter more finely, so that its surface is somewhat shining. Petiole coarsely reticulate-rugose, its truncated posterior surface finely rugulose. Postpetiole, gaster, and legs smooth, with fine piligerous punctures.

Hairs and pubescence as in the worker, but shorter.

Head, postpetiole, and gaster castaneous; thorax and petiole black, neck and discal portion of mesonotum red; antennae, palpi, and legs, including the coxae, yellow, the tibiae streaked with fuscous or black. Wings clear yellowish hyaline; pterostigma brown, veins yellow.

A single specimen, which I have described in detail, because very few Bothroponera males have been seen.

*6. PSEUDOPONERA AMBLYOPS (Emery) ♀.

*7. TRAPEZIOPELTA BREVILOBA, sp. nov.

Female. Length 5.8 mm.

Head, excluding the mandibles, a little broader than long, slightly broader behind than in front, with feebly rounded sides and feebly and broadly excised occipital border. Eyes rather convex, longer than their distance from the anterior corners of the head. Ocelli small and close together. Mandibles distinctly shorter than the head, slender and terete at the base, dilated and flattened apically, their inner borders with three separated teeth; the most basal merely a low, rounded convexity, the others stronger and decidedly acute. Lobe of clypeus very short, rectangular, more than twice as broad as long, its anterior border slightly concave. Oral border of clypeus with a median, slender, truncated tooth. Frontal groove strongly impressed. Antennal scapes not reaching to the posterior border of the head; funiculi with distinctly 4-jointed club; joints 2–7 slightly broader than long; joints 8–10 onger than broad; terminal joint nearly as long as the three remaining joints of the club together. Thorax 2½ times as long as broad, parallel-sided, distinctly narrower than the head, flattened above; pronotum, excluding the neck, about as long as the mesonotum; base and declivity of epinotum forming nearly a right angle in profile, the declivity slightly concave. Petiole, postpetiole, and gaster together but little longer than the thorax, the petiole truncated anteriorly and posteriorly, higher than long, from above broader than long and broader behind than in front, with rounded dorsal and lateral surfaces, its ventral surface in front with a blunt, compressed tooth. Postpetiole rather strongly constricted behind, its anteroventral surface with an acute, downwardly directed tooth. Sting long and compressed.

Smooth and shining; head, thorax, and abdomen with small, sparse, inconspicuous, piligerous punctures.

Hairs yellow, bristly, pointed, of uneven length; sparser on the body and legs, suberect on the former, oblique on the latter; more abundant but short on the antennae.

Deep red; antennae, legs, and mandibles slightly yellowish red. Wings uniformly brown, with dark brown veins and conspicuous black pterostigma.

Described from a single specimen.

This does not seem to be the female of any of the described species, nearly all of which are known only from worker specimens. It is evidently most closely related to the Papuan *T. laevigata* Emery, the female of which is still to be discovered.

8. DORYLUS LAEVIGATUS (Smith) ♂. (*Ante*, p. 61).

9. TETRAPONERA ATTENUATA Smith ☿ ♀ ♂. (*Ante*, p. 65).

10. TETRAPONERA DIFFICILIS Emery (?) ♀. (*Ante*, p. 65).

11. TETRAPONERA PILOSA (Smith) ☿ ♀. (*Ante*, p. 65).

12. MYRMICARIA ARACHNOIDES (Smith) subsp. MELANOGASTER Emery ♀. (*Ante*, p. 71).

13. VOLLENHOVIA RUFIVENTRIS Forel ♀. (*Ante*, p. 79).

*14. VOLLENHOVIA OBLONGA Smith var. (?) ♀.

15. PRISTOMYRMEX TRACHYLISSUS (Smith) ♀. (*Ante*, p. 86).

*16a. PARATOPULA, gen. nov. CEYLONICA (Emery) var. SUMATRENSIS (Forel) ♀.

I have received all three phases of this ant from the Philippines (F. X. Williams). The typical form of the species, originally described as *Atopomyrmex ceylonicus*, has recently been placed by Forel in the genus Leptothorax. As I cannot agree with this allocation and as the species cannot be left in Atopula, I have coined a new generic name, Paratopula.

17. Meranoplus mucronatus Smith ☿. (*Ante*, p. 90).

18. Cataulacus granulatus (Latreille) ♀. (*Ante*, p. 92).

19. Cataulacus hispidulus Smith ☿. (*Ante*, p. 93).

20. Cataulacus latissimus Emery ☿. (*Ante*, p. 94).

*21. Myrmoteras bakeri, sp. nov.

Female. Length nearly 4 mm.

Very similar to *M. donisthorpei* Wheeler, but differing in the following characters: the five large teeth along the apical half of the mandibles are distinctly longer and stouter, though alternating with shorter teeth as in *donisthorpei*, whereas the denticles on the basal half are very small and almost obsolete; the frontal carinae are somewhat further apart; the lateral lobes of the head just behind the eyes are more acutely angular; the petiolar node is much more compressed anteroposteriorly so that its upper border is transverse and rather sharp; the middle and hind tibiae are less strongly swollen in the middle and the sculpture and color are different. The head is very smooth and shining like the remainder of the body, and the insect is honey-yellow, with the mandibles, except their brownish teeth, the femora and tarsi paler, whitish yellow. The middle portion of the first gastric segment and the bases of the succeeding segments are brownish. The pilosity and wing-venation are as in *donisthorpei*, but the erect hairs on the scapes, body and legs are somewhat coarser and more bristly.

Male. Length 3 mm.

Head through the eyes broader than long, gradually contracted and rounded behind, without the peculiar lobular eminences of the female, to the concave and marginate occipital border. Eyes large, but placed far forward, so that the cheeks are very short. Ocelli small. Mandibles very small, vestigial, bluntly pointed, edentate. Clypeus, frontal carinae, and antennae much as in the female, except that the antennae are 13-jointed. Thorax, gaster, and legs as in the female; middle and hind tibiae less incrassated, petiolar node thicker and much blunter above. Genital appendages small, exserted, superficially like those of Prenolepis. Wings as in the female, with the same peculiar venation.

Smooth and shining; thorax subopaque, finely punctate-rugulose.

Pilosity as in the female but somewhat sparser and finer.

Castaneous brown; pronotum and head paler and more reddish; palpi and tarsi beyond the first joint, whitish.

Described from a single female and three males. More material may show that this form is merely a pale race, or subspecies of *donisthorpei.* The color of the female before me is certainly not due to immaturity. Dr. F. X. Williams has recently sent me a male and female of another species, *M. williamsi,* sp. nov., from the Philippines, the fourth species of this remarkable genus to come to light in the Malayan subregion. The female is larger and more robust than *donisthorpei* and *bakeri,* with the head and thorax rich reddish brown, opaque, and very finely and densely punctate and the basal half of the swollen middle and hind tibiae black, the apical half yellow. The male is black, with pale terminal tarsal joints and the head and thorax are densely punctate-rugose. The worker is known only of the type-species, *M. binghami* Forel of Burma.

22. CAMPONOTUS (MYRMOTARSUS) MISTURA (Smith) ☿.
(*Ante,* p. 109).

*23. CAMPONOTUS (MYRMOTARSUS) SATAN, sp. nov.

Female. Length: 18 mm.; wings 19 mm.

Head subtrapezoidal, broader than long without the mandibles, much broader behind than in front, with straight sides and broadly excised posterior border. Eyes moderately large and convex. Mandibles large, convex, with 6 large, subequal teeth. Clypeus broader than long, rather flat, ecarinate; its anterior margin straight and transverse in the middle, with a small tooth in each side and feebly concave lateral to each tooth. Frontal carinae slightly diverging behind and not strongly curved. Antennal scapes decidedly flattened, reaching to the posterior corners of the head. Thorax and legs as in the other species of the subgenus. Petiole broad, cuneate in profile, its anterior and posterior surfaces flat, its superior margin moderately sharp, feebly and sinuately emarginate. Gaster considerably shorter than the thorax. Tibiae and middle and hind metatarsi flattened as in other species of the subgenus. Wings long.

Very smooth and shining except the sides of the thorax and the top of the head, which are opaque. Mandibles, clypeus, and cheeks sparsely punctate, the punctures becoming finer and denser on the sides of the head; the opaque dorsal portion sharply and finely coriaceous.

Hairs black, rather short, coarse, moderately abundant, erect, absent on the cheeks but covering the body and appendages, short on the scapes; venter and borders of gastric segments above, and lower surfaces of tarsal joints with short, appressed fulvous hairs. Pubescence absent.

Deep black; terminal tarsal joints reddish. Wings brown with resin colored veins and apterostigma bordered with darker brown.

A single specimen. This species is quite distinct in the shape of the head, sculpture and color of the pilosity.

24. CAMPONOTUS (MYRMOSPHINCTA) CAMELINUS (Smith) ☿. (*Ante*, p. 111).

24a. CAMPONOTUS (MYRMOSPHINCTA) CAMELINUS var. SINGULARIS (Smith) ☿. (*Ante*, p. 112).

25. POLYRHACHIS BIHAMATA (Drury) ☿ ♀. (*Ante*, p. 121).

26. POLYRHACHIS (MYRMA) VINDEX Smith ☿. (*Ante*, p. 125).

A single specimen, differing from the typical form described on p. 125 in having the legs entirely black.

27. POLYRHACHIS (MYRMHOPLA) ARMATA (Le Guillou) ☿. (*Ante*, p. 129).

28. POLYRHACHIS (MYRMHOPLA) FURCATA Smith ♀. (*Ante*, p. 131).

29. POLYRHACHIS (MYRMHOPLA) CHALYBEA Smith ☿. (*Ante*, p. 131).

30. POLYRHACHIS (MYRMHOPLA) CEPHALOTES Emery ☿. (*Ante*, p. 132).

31. POLYRHACHIS (CYRTOMYRMA) RASTELLATA (Latreille) ☿. (Ante, p. 136).

A specimen with the legs entirely black.

32. ECHINOPLA PALLIPES Smith ☿. (*Ante*, p. 138).

The following Publications of the Museum of Comparative Zoölogy are in preparation;—

LOUIS CABOT. Immature State of the Odonata, Part IV.
E. L. MARK. Studies on Lepidosteus, continued.
E. L. MARK. On Arachnactis.

Reports on the Results of Dredging Operations in 1877, 1878, 1879, and 1880, in charge of ALEXANDER AGASSIZ, by the U. S. Coast Survey Steamer "Blake," as follows:—

A. MILNE EDWARDS and E. L. BOUVIER. The Crustacea of the "Blake."
A. E. VERRILL. The Alcyonaria of the "Blake."

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieutenant Commander Z. L. TANNER, U. S. N., Commanding, in charge of ALEXANDER AGASSIZ, as follows:—

K. BRANDT. The Sagittae.
K. BRANDT. The Thalassicolae.
O. CARLGREN. The Actinarians.
R. V. CHAMBERLIN. The Annelids.
W. R. COE. The Nemerteans.
REINHARD DOHRN. The Eyes of Deep-Sea Crustacea.
H. J. HANSEN. The Cirripeds.
H. J. HANSEN. The Schizopods.
W. A. HERDMAN. The Ascidians.
S. J. HICKSON. The Antipathids.
E. L. MARK. Branchiocerianthus.
JOHN MURRAY. The Bottom Specimens.
P. SCHIEMENZ. The Pteropods and Heteropods.
THEO. STUDER. The Alcyonarians.
H. B. WARD. The Sipunculids.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of ALEXANDER AGASSIZ, on the U. S. Fish Commission Steamer, "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., Commanding, as follows:—

R. V. CHAMBERLIN. The Annelids.
H. L. CLARK. The Holothurians.
—— The Volcanic Rocks.
—— The Coralliferous Limestones.
S. HENSHAW. The Insects.
G. W. MÜLLER. The Ostracods.
MARY J. RATHBUN. The Crustacea Decapoda.
G. O. SARS. The Copepods.
L. STEJNEGER. The Reptiles.
T. W. VAUGHAN. The Corals, Recent and Fossil.
A. WETMORE. The Mammals and Birds.

PUBLICATIONS
OF THE
MUSEUM OF COMPARATIVE ZOÖLOGY
AT HARVARD COLLEGE.

There have been published of the Bulletin Vols. I. to LIV., LVI., and Vols. LVIII. to LXII.; of the Memoirs, Vols. I. to XXXVIII., and also Vols. XL. to XLII., XLIV. to XLVI.

Vols. LV., LVII. and LXIII. of the Bulletin, and Vols. XXXIX., XLIII., XLVII. to XLIX. of the Memoirs, are now in course of publication.

The Bulletin and Memoirs are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by students and others in the different Laboratories of Natural History, and of work by specialists based upon the Museum Collections and Explorations.

The following publications are in preparation:—

Reports on the Results of Dredging Operations from 1877 to 1880, in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," Lieut. Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., commanding.

Reports on the Results of the Expedition of 1891 of the U. S. Fish Commission Steamer "Albatross," Lieut. Commander Z. L. Tanner, U. S. N., commanding, in charge of Alexander Agassiz.

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., commanding.

Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, on the U. S. Fish Commission Steamer "Albatross," from October, 1904, to April, 1905, Lieut. Commander L. M. Garrett, U. S. N., commanding.

Contributions from the Zoölogical Laboratory, Professor E. L. Mark, Director.

Contributions from the Geological Laboratory, Professor R. A. Daly, in charge.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Mass.

ON THE OCCURRENCE OF A MERMIS EPIDEMIC AMONGST GRASSHOPPERS

By R. W. GLASER and A. M. WILCOX

Reprinted from Psyche, Vol. XXV, No. 1

ON THE OCCURRENCE OF A MERMIS EPIDEMIC AMONGST GRASSHOPPERS.[1]

BY R. W. GLASER and A. M. WILCOX.

While engaged in some investigations on grasshoppers, near Dummerston Station, southern Vermont, this past summer (1917), our attention was attracted to a high mortality amongst these insects (*Melanoplus atlanis* and *M. bivittatus*). The two species, especially *M. atlanis*, are extremely bad pests in this region of the country, attacking corn, wheat, oats and clover to such an extent that during certain summers the farmers become nearly frantic. Therefore, the high mortality amongst the grasshoppers, which appeared during the latter part of August and the early part of September, was exceedingly gratifying.

We soon discovered that this mortality was due to a species of Nematode belonging, as we supposed at the time, probably to the family Mermithidæ. Subsequently (Sept. 20, 25 and Oct. 6), we sent large shipments of these worms to Dr. N. A. Cobb, of Washington, D. C., for identification. Dr. Cobb was able to give us only a provisional identification on account of the utter absence of males in all of our shipments. We made collections of parasitized grasshoppers from a large variety of fields and as stated, sent a large number of specimens, but curiously enough no males were found. Dr. Cobb in a letter said: "Nothing I have learned would preclude your specimens from belonging to the same species as that referred to by Leidy under the name of *Mermis ferruginea*, which he says was common in *Locusta carolina* near Philadelphia; but there can be no certainty about the matter until males of the present species are obtained and a comparison made with Leidy's material, which may or may not be in existence." Dr. Cobb further stated that after the nematodes leave the grasshoppers, they make their way into the soil and that their further history is obscure.

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[1] Contribution from the Entomological Laboratory of the Bussey Institution in coöperation with the U. S. Bureau of Entomology. Bussey Institution, No. 146.

In Vermont the nematodes parasitized both *M. atlanis* and *M. bivittatus*. The worms seem to leave the bodies of the grasshoppers when these insects are maturing. We had not the opportunity to observe grasshoppers in the early stages of parasitism, but in August and September dissection of a large number of the insects showed that the worms were located within the body cavity. Later in the season, when the worms are about to emerge, the grasshoppers fall over on one side, kick for a time and then die. In the meantime, the worms gradually bore their way through the body wall and reach the exterior after which they make their way slowly into the earth. Usually only one worm parasitizes a grasshopper, but by dissection we have often found two or three and in one case we found forty. Needless to say, that when an insect contains so many worms the abdomen is considerably swollen.

The length of these female worms varied from two to eight inches. It is extraordinary that with hundreds of hoppers dying everywhere, we were unable to find any males.

A great many nematodes, at one stage of their life cycle, seek water on leaving their hosts and there mature, or wait until another host presents himself. We placed about two dozen of our worms in a bowl of water in which they seemed to flourish for about two weeks. However, the localities where the hoppers, and consequently the worms abounded were free from streams, ponds or marshes of any kind. The Connecticut River flows through a valley at a distance of about one-half mile so it seemed unlikely that the worms would travel so far. In all probability, we thought, the worms make their way into the soil on leaving the insects and this we found true. We placed recently dead parasitized hoppers in boxes containing earth. In about three days the boxes were examined and the worms were found coiled up at a depth of about one foot. Often a number would be coiled up together in one spot. An examination of the soil in the fields revealed quantities of the worms below the surface at a distance of six inches to one foot. November the 7th and 8th, long after the grasshopper season, the ground now cold was again broken and the nematodes were found coiled up at about the same distance below the surface. Undoubtedly they hibernate in these positions.

During the highest mortality we made a series of dissections in order to determine the per cent. of parasitism. On a place called the Halladay Farm, we obtained the following astonishing high figures by the dissection of *M. bivittatus.*

Sept.	8.	100 ♀ ♀	dissected and worms found in	59%.
“	10.	80 ♀ ♀	“ “ “ “ “	76%.
“	12.	50 ♀ ♀	“ “ “ “ “	62%.
“	8.	40 ♂ ♂	“ “ “ “ “	12%.
“	10.	60 ♂ ♂	“ “ “ “ “	21%.
“	12.	100 ♂ ♂	“ “ “ “ “	12%.

On a place called the Tarbox Farm, we dissected about equal numbers of *M. bivittatus* and *M. atlanis* and obtained the following:

Sept.	8.	100 ♀ ♀	dissected and worms found in	22%.
“	10.	75 ♀ ♀	“ “ “ “ “	25%.
“	12.	60 ♀ ♀	“ “ “ “ “	25%.
“	8.	90 ♂ ♂	“ “ “ “ “	3%.
“	10.	80 ♂ ♂	“ “ “ “ “	5%.
“	12.	100 ♂ ♂	“ “ “ “ “	2%.

In both series of dissections it will be noticed that the percentage of parasitism in females is much higher than in males. Since the life-history of the worm is still so obscure we are at present unable to offer any explanation for this fact.

How the grasshoppers become infected is unknown. Since the nematodes are so large when they leave the grasshoppers in order to burrow into the soil, we are under the impression that grasshoppers are the secondary hosts. It is difficult to imagine what animal might constitute the primary host. Perhaps some other insect may furnish the clue to this interesting question.

Next summer we hope to extend our observations and attempt to gain a more complete insight into the life-history of this *Mermis* parasite. Some parasites fluctuate so numerically from one season to another, that an entirely different condition may, of course, present itself in 1918. We mean that the worms may not be so plentiful for some reason and if this should prove true, it will be difficult to obtain very much information.

From our observations this summer (1917) we firmly believe that the nematodes accomplished an immense reduction in the number of grasshoppers near Dummerston Station, Vermont. This worm, if its life-history is investigated, might offer possibilities for introduction into regions where it does not occur and where grasshoppers are a pest. For this reason, and because we were unable to find any records of such a high degree of parasitism, we thought it best to present these preliminary observations.

A STUDY OF SOME ANT LARVÆ, WITH A CONSIDERATION OF THE ORIGIN AND MEANING OF THE SOCIAL HABIT AMONG INSECTS.

By WILLIAM MORTON WHEELER.

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A STUDY OF SOME ANT LARVÆ, WITH A CONSIDERATION OF THE ORIGIN AND MEANING OF THE SOCIAL HABIT AMONG INSECTS.[1]

By WILLIAM MORTON WHEELER.

(*Read April 19, 1918.*)

The care lavished by ants on their brood is a matter of such frequent and easy observation that it has always excited wonder and comment. When a colony is disturbed at the height of the breeding season the brood is at once seized and carried to a place of safety, and when more closely observed in artificial nests the behavior of the workers is seen to be very largely a constant round of the four different activities of feeding, licking, transporting and defending the young. Swammerdam says in that wonderful volume, the "Biblia Naturæ" (1737–1738): "Incredible *στοργῇ* et cura Formicæ educant summamque dant operam, ne vel tantillum quod spectet eorum Vermiculorum educationem atque nutritionem omittant"—"with incredible affection and care the ants bring up their vermicules and omit not the least thing appertaining to their education and nurture." He intentionally uses the word *στοργή*, from the verb *στέργειν*, to express his belief that love or affection impels the ant to care for her young, since there is no Latin equivalent for a term which to the Greek meant the affection of the members of a human family for one another as distinguished from other forms of "tender feeling."[2] And observers since Swammerdam seem uniformly to have agreed with him, though more modern writers often use such terms as "care of the brood" as more suited to the present colorless and noncommittal stage of natural history.

Now it must be conceded that Swammerdam's statement calls

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 147.

[2] Plato in the "Laws," 754B, uses the verb in its typical Greek sense when he says: *παῖς στέργει τε καὶ στέργεται ὑπὸ τῶν γεννησάντων.*

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attention to a real problem, but one that belongs to the psychologist and not to the biologist. I am quite willing to admit that there may be in ants some feeble analogue of the parental feelings of man and the highest animals, but as a biologist I am bound to seek and if possible to find some ethological or physiological basis for the ant's behavior toward her brood. Like other students of insects I have, no doubt, often taken too much for granted and have unquestionably committed the eighth deadly sin, called by the orthodox behaviorists "anthropomorphism," not once but many times. By way of partial penance I offer the following paper.

I confess that I took the Swammerdamian conception for granted till recently, while studying a collection of ants made in the Belgian Congo for the American Museum of Natural History by my friend Mr. H. O. Lang, I came upon some facts which seem to throw a flood of light on the true meaning of the relations of ants to their brood. These relations now appear to me so simple and unequivocal that I find difficulty in understanding how they could have remained so long unperceived, especially as a host of other facts had been insistently pointing in the same direction. Our blindness seems to have been due to regarding the adult ants as the only active factors in the brood relationship. We supposed that the larvæ, probably because they are such sluggish, legless maggots, were merely the inert and passive objects of the feeding, licking, transportation and protection. One result of this assumption has been a general neglect of the study of larval ants. Even their morphology has received little attention. There are a few valuable papers by Berlese (1901), Karawaiew (1896) and Pérez (1902) on the metamorphosis of ants, a single paper by Emery (1899) devoted to the external characters of the larvæ in a selected series of species and a number of scattered descriptions and figures, published mainly for taxonomic purposes, by myself and others.

I regret that in the past I failed to study the larval ants more closely and more continuously, especially as the meaning of some of the unpublished records in my notebooks of 1899 and 1900 is clear to me only now after the lapse of nearly twenty years. When I took up my work at the University of Texas in the fall of 1899 as a morphologist accustomed to well-furnished northern and European embryological and anatomical laboratories and libraries, I found so little apparatus for the work in which I had been trained, that I fell into a peculiar listlessness and was for some weeks unable to concentrate my attention on any subject that seemed worthy of investigation. One day, while I sat on the bank of Barton Creek, near Austin, in the very spot where, as I later learned, MacCook had worked on the famous agricultural ant (*Pogonomyrmex molefaciens*), I happened to see a file of cutting ants (*Atta texana*), each with its piece of leaf poised in its mandibles. I vividly remember the thrill of delightful fascination with which I watched the red-brown creatures trudging along under their green loads, and it seemed to me that I had at last found a group of organisms that would repay no end of study. At that time there was no active myrmecologist in the country. MacCook had completed his work and Pergande was no longer deeply interested in the ants. Prof. Emery, however, and later Prof. Forel extended helping hands to me and forthwith sent me their numerous and important publications, and several of my students, notably C. T. Brues, A. L. Melander, C. G. Hartman and W. A. Long, never wearied of accompanying me on long excursions into the dry, sunny woods and canyons about Austin.

For a time I was greatly interested in the habits of three large ants of the primitive subfamily Ponerinæ, *Odontomachus clarus, Pachycondyla montezumæ* and *Lobopelta elongata,* which are common in Central Texas. I was able to show that their peculiar tuberculate larvæ are not fed with regurgitated food, like the larvæ of more specialized ants, but with pieces of insects (1900). Concerning the feeding of the *Odontomachus* larva I published the following remark (p. 24):

> These larvæ are placed by the ants on their broad backs, and their heads and necks are folded over onto the concave ventral surface, which serves as a table or trough on which the food is placed by the workers.

An unpublished note, the significance of which I did not appreciate at the time, refers to *Pachycondyla* and was recorded while I was studying the behavior of its extraordinary Phorid commensal, *Metopina pachycondylæ* (1901). It runs as follows:

> As soon as the fragments of insects are placed on the larva's trough-like ventral surface, the latter is sometimes inundated with a copious, colorless liquid, which is at once eagerly lapped up by the attendant nurse.

I should now describe this behavior in the following words: As soon as the fragments are placed on its ventral surface, the larva discharges from its salivary glands a supply of secretion which is sometimes very abundant. This secretion, by means of a strong proteolytic ferment which it contains, digests the food extraintestinally and thus enables the larva to swallow and assimilate it, and at the same time serves in part as an agreeable draught for the nurse. The strong mandibles of the Ponerine larvæ are used for comminuting the insect food and thus preparing it for the action of the saliva. The larval feeding habits of our small northern species of *Ponera* and *Stigmatomma* are essentially the same as those of the Texan genera, as I showed in a special paper (1900a).

Within recent years I have examined the larvæ of a number of different Ponerinæ and have found them all to possess well-developed mandibles. All, in my opinion, except, perhaps, during their very youngest stages, are fed with fragments of insects, supplied directly by their nurses. In some species, the insect prey is probably given to the larva without previous dismemberment. I here describe and figure the young of three genera, *Myrmecia, Megaponera* and *Bothroponera,* as they differ considerably from one another and from all previously described Ponerine genera and will serve therefore to illustrate the diversity of larval structure within the subfamily.

Fig. 1 is from a photograph of the adult larva of *Myrmecia sanguinea,* one of the larger Australian bulldog ants, the most primitive of existing Formicidæ. It is milk-white, has the form of a vegetable marrow, with all the segments distinct, except those at the extreme posterior end of the body, the anterior segments are very slender and curved and the head is very small. The body is rather uniformly clothed with short, rapidly tapering, bristle-like hairs. Under a higher magnification the head (Fig. 2) is seen to have a projecting bilobed clypeus (*c*), broad, heavily chitinized, coarsely tridentate mandibles (*m*) and well-developed maxillæ (*x*) and labium (*l*), the former with two pairs of strongly chitinized pegshaped sensillæ (s'), the latter terminating in a broadly elliptical chitinous plate, with a single pair of knob-shaped sensillæ (s'') and the opening of the salivary duct (d) near the middle of its anterior border. The upper surface of the short, rounded cranium bears a pair of minute antennal rudiments (n). When I collected this larva in New South Wales I was unable to learn anything of its feeding habits. Indeed, he who would make such observations would have to don a suit of armor specially designed to ward off the stings of this powerful and ferocious ant or be able to keep it in a large artificial nest. As I was continually travelling about I was unable to resort to the latter alternative. It is, however, not improbable that the *Myrmecia* larva is fed on whole insects, since the small head and very long mobile neck are very much as in certain solitary wasp larvæ (*e. g., Sphecius*), which gnaw a small hole in their prey and

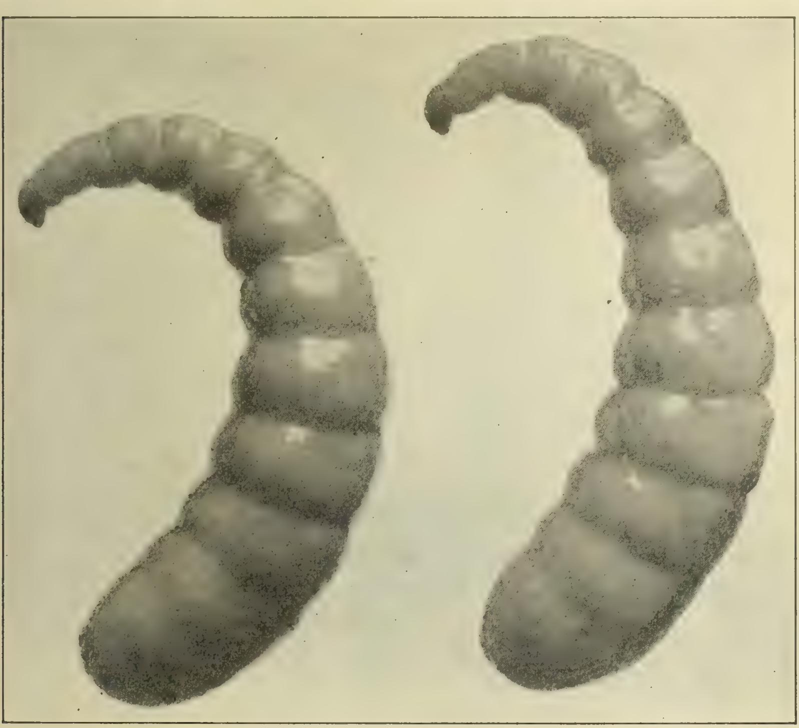

FIG. 1. Adult larvæ of *Myrmecia sanguinea* Fabr.

then reach into its body cavity and devour its soft parts. The mandibles of the *Myrmecia* larva certainly show that it feeds on insect food.

The second larva (Fig. 3) is that of the "Matabele ant," *Megaponera fœtens,* of which Mr. Lang secured many specimens in the Belgian Congo. Arnold (1914) and others have shown that this

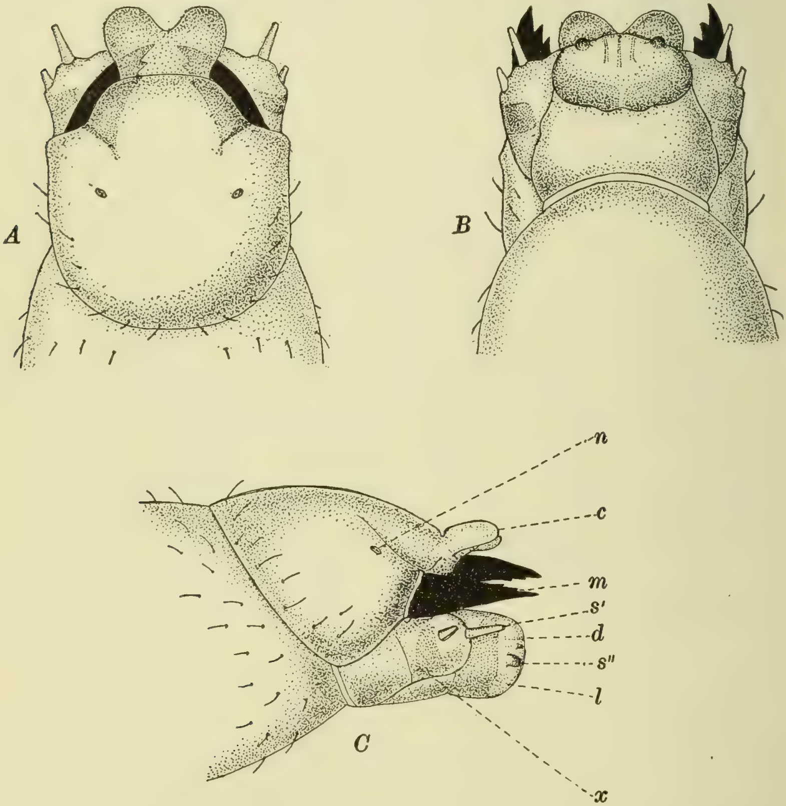

Fig. 2. Head of *Myrmecia sanguinea* larva. *A,* dorsal; *B,* ventral; *C,* lateral view; *n,* antenna; *c,* clypeus; *m,* mandible; *x,* maxilla; *s,* maxillary sensilla; *l,* labium; *s'',* labial sensilla; *d,* opening of salivary duct.

ant preys on termites, the bodies of which it carries home agglutinated in the form of pellets (Alluaud in Santschi, 1914). It is very restless and changes its nesting site frequently, so that it is obliged to carry its young about a great deal and for considerable distances.

The larva is cylindrical, covered with a very tough, opaque, grayish, hairless skin and furnished with long, falcate mandibles. The pupa is enclosed in a very tough, black cocoon. These peculiarities are evidently adaptations to exposure to the air and light, to the exigencies of frequent and protracted transportation and to feeding on the bodies of termites brought into the nest by the workers. Mr. Lang actually observed the exposure of the black cocoons to the sunlight, a peculiarity of behavior which I had also observed in certain Australian Ponerinæ of the genera *Diacamma* and *Rhytidoponera* (1915).

The third larva (Fig. 4), that of *Bothroponera sublævis,* one of four species of the genus, which I collected in Australia, has a very broad elliptical body, with a short, stout neck, strongly folded over onto the ventral surface, which is somewhat concave. The integument is also hairless and of a peculiar opaque, gray color. The sides of the three thoracic segments and first abdominal segment are furnished with fleshy tubercles and the mouthparts are very highly developed. It is placed on its back by the nurses and fed with fragments of insects deposited on its trough-like ventral surface as in our North American Ponerinæ.[3]

The feeding of the larvæ with pieces of insect food is not, however, confined to the Ponerinæ. Miss Fielde and I have shown that one of the commonest Myrmicine ants of the North Eastern States, *Aphænogaster fulva,* has the same habit. During late June, at the height of the breeding season, it is hardly possible to remove the stone covering a nest of this ant without finding one or more larvæ lying on their backs or sides in the act of feeding on the legs of flies or fragments of other small insects. Janet has observed similar behavior in *Tetramorium cæspitum* and in some Camponotine ants of the genus *Lasius*. Hungry larvæ of *Aphænogaster* will even attack and devour smaller larvæ of their own species that lie within reach of their sharp mandibles.

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[3] Mayr described *Bothroponera* as a genus, but Emery, Forel and Santschi have been treating it as a subgenus of *Pachycondyla.* I return to Mayr's conception, because the adult, at least, of the Australian species of *Bothroponera* exhibits several peculiarities of behavior, such as the extrusion when captured of a mass of frothy bubbles from the tip of the gaster, and because of the structure of the larva, which is very different from that of *Pachycondyla* as will be seen by comparing Fig. 4 with my previously published figures of *P. montezumæ.* The larvæ of *Diacamma, Leptogenys* and *Odontomachus* bear a greater resemblance to those of *Pachycondyla. Bothroponera* is, moreover, confined to tropical Africa, Asia and Australia, whereas *Pachycondyla* is neotropical.

Still the very young larvæ of *Aphænogaster* and possibly also of the Ponerinæ are fed with liquid food regurgitated on their mouths by the workers. Miss Fielde thus describes the process in *Aphænogaster* (1901):

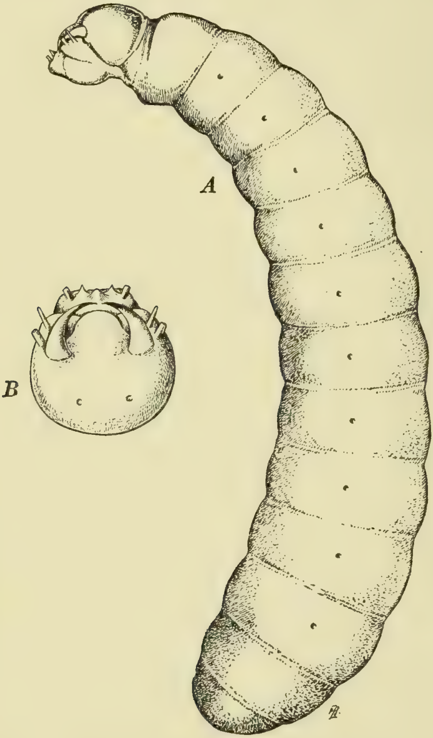

FIG. 3. *A,* nearly adult larva of *Megaponera fœtens* Fabr.; *B,* head of same, dorsal view.

> The feeding of the larva, which is bent nearly double in the egg, with regurgitated food begins as soon as it straightens itself and protrudes its mouth. When the larvæ begin to appear in the egg-packet, the workers lift the packet and hold it free and still, while one of their number holds a translucent white globule of regurgitated food to the larval mouth projecting from

> the surface of the egg-packet. I have repeatedly seen the workers thus feeding the very young larvæ, a single globule of regurgitated food serving for a meal of which four or five larvæ successively partook.

Undoubtedly the majority of Myrmicinæ, Dolichoderinæ and Camponotinæ, the three most highly specialized subfamilies of ants, feed the brood throughout its larval stages with regurgitated liquids. Concerning larval feeding in the Dorylinæ nothing is known.

I come now to a consideration of some of the ant larvæ collected by Mr. Lang in the Belgian Congo. Four of these, all belonging to the subfamily Myrmicinæ, are of unusual interest. One of the species is a new *Pœdalgus* which I shall describe elsewhere as *P. termitolestes* sp. nov., the third of the genus to come to light, as only one Indian and one other West African species were previously known. The workers of *termitolestes* are minute brownish yellow ants which live in the masonry of large termite hills and undoubtedly prey on their inhabitants. Their habits therefore resemble those of the well-known thief-ants, *Solenopsis molesta* of North America and *S. fugax* of Europe. The larva (Fig. 5) has a singular shape, being almost spherical, with a short neck, small head and minute, bidenticulate mandibles. The delicate integument is studded with very short, stiff hairs, each of which has two recurved branches. The larvæ, which are held together in compact masses by the interlocking of these hooked hairs, are fed with liquid food by regurgitation as is evident from the contents of their large spherical stomachs and the very feeble development of their mouthparts. Although, like other Myrmicinæ, they do not spin cocoons but form naked pupæ, they nevertheless possess huge salivary glands. Even in the very young larva (Fig. 5*A*) the salivary receptacle on each side is full of a clear liquid secreted by the large cells of the two branches of the gland. In the nearly full-grown female larva (Fig. 5*B*) the glands are very voluminous and have their lumen and that of the receptacle full of secretion shown as dark, compact masses in the figure, which was, of course, drawn from a specimen hardened and dehydrated in alcohol. As such an amount of saliva would hardly be necessary for digestive purposes and as it is not used in the form of silk by the full-grown larva, it probably serves as a store of food for the nurses. The *Pœdalgus* larvæ, therefore, would seem to resemble the repletes of honey ants (*Myrmecocystus, Leptomyrmex,* etc.), except that the food for the workers is metabolized and stored as saliva by the larva, instead of merely being ingurgitated and stored in the ingluvies, or crop by a certain number of workers. From the fact that other Myrmicine ants, although they spin no cocoons, often have well-developed salivary glands, we may infer that these organs have much the same function as in *Pædalgus.* To prove this, however, additional observations are necessary, though other reasons for believing it to be the case, will appear in the sequel. In all the larval stages of the Dolichoderinæ and in the immature larvæ of Camponotinæ the salivary glands are probably put to a similar use. In the species of *Œcophylla* and *Polyrhachis* that employ their young larvæ for spinning the silken portions of

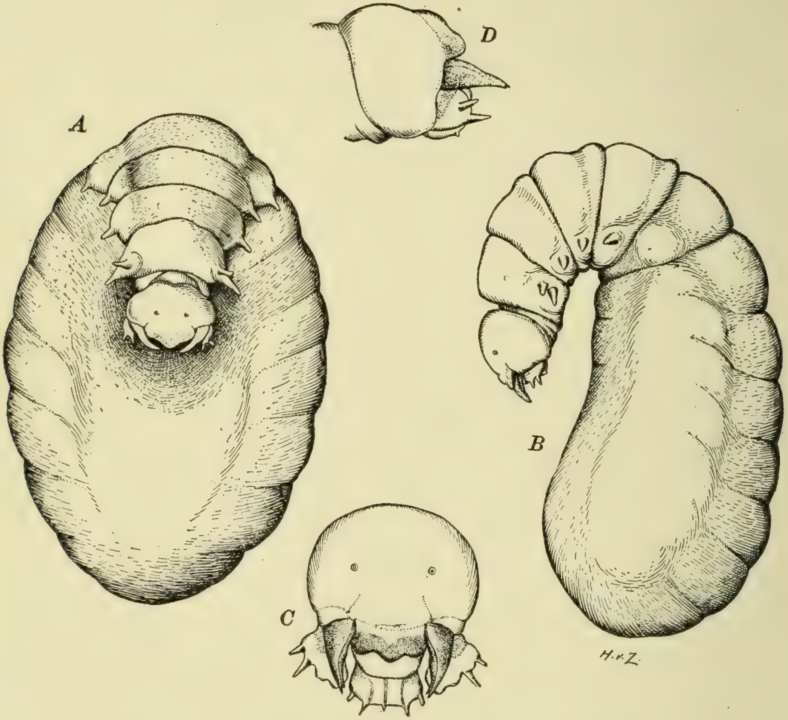

FIG. 4. Adult larva of *Bothroponera sublævis* Mayr. *A,* ventral; *B,* lateral view; *C,* head, dorsal view; *D,* head, in profile.

the nest inhabited by the whole colony, we must suppose that the spinning habit, which in other Camponotine ants is manifested only at the end of larval life, has become secondarily precocious, but even in such larvæ the saliva in the stages immediately after hatching may, perhaps, still serve as an agreeable draught for the nurses.

The three remaining larvæ which I wish to describe belong to species formerly included in the genus *Sima* but now for taxonomic reasons referred to *Tetraponera* and *Pachysima.* These ants live in hollow twigs like the species of the closely related neotropical genus *Pseudomyrma.* A large collection of *Tetraponera tessmanni,* made by Mr. Lang, included larvæ and pupæ in all stages of de-

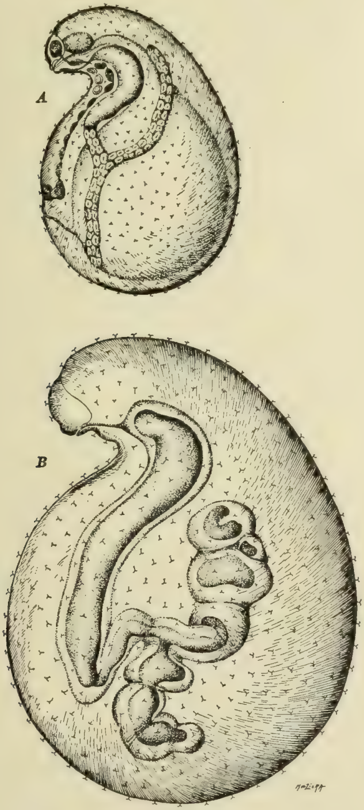

FIG. 5. *A,* very young; *B,* nearly adult larva of *Pædalgus termitolestes* sp. nov.; lateral view to show the development of the salivary glands.

velopment. The adult larva differs little from the youngest and is shown in Fig. 6. It is long, cylindrical and hypocephalic, *i. e.,* with the head on the ventral side instead of being terminal. Unlike the various larvæ described above, it has a pair of swollen appendages, belonging to the prothoracic segment and applied to the sides of the head, and a large protuberance, evidently representing a pair of fused appendages, on the ventral side of the first abdominal segment. The dorsal surface is furnished with long, hook-shaped hairs, by means of which the larva is evidently suspended from the walls of the nest in the same manner as some of our American ant larvæ (*Pheidole, Leptothorax,* etc.) which have similar dorsal hairs.

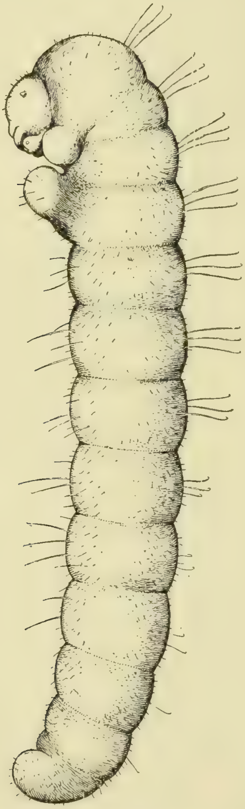

FIG. 6. Adult larva of *Tetraponera tessmanni* Stitz.

Other larvæ of *Tetraponera* (*natalensis, allaborans,* etc.) are not unlike those of *T. tessmanni.*

The meaning of the thoracic and abdominal appendages becomes clear when we examine the larvæ of *Pachysima æthiops* and *latifrons.* Four distinct stages, probably separated by moults, or ecdyses, may be recognized in *æthiops.* The first stage larva, just after hatching, is represented in Fig. 7 as it appears in ventral and lateral view. The body is curved, convex dorsally and concave ventrally, and terminates behind in a cylindrical projection, with the anus shifted to the ventral surface near its base. The creature is strongly hypocephalic like the larval *Tetraponera* and *Pseudoponera.* The head is surrounded by a cluster of prominent, tubercle-like appendages. On the prothorax, which is large and forms a great hood over the head, there are three pairs of these appendages, an anterior truncate pair, a median pointed pair and a large posterior pair,

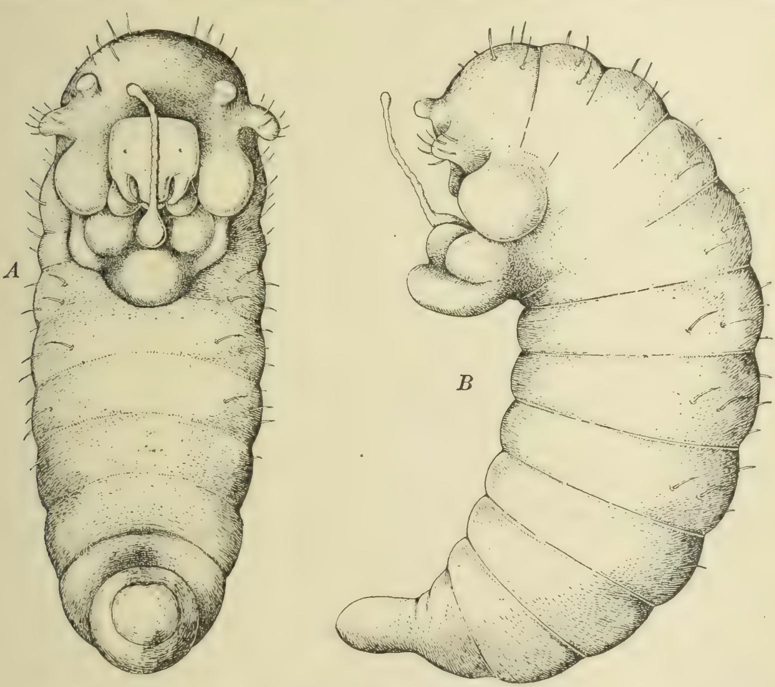

FIG. 7. First larva stage ("trophidium") of *Pachysima æthiops* F. Smith. *A,* ventral; *B,* lateral view.

swollen and rounded and embracing the sides of the head. These evidently correspond to the single prothoracic pair of the *Tetraponera tessmanni* larva. The mesothoracic segment has a pair of smaller appendages nearer the mid-ventral line. Between them arises a very peculiar organ with a swollen, pear-shaped base prolonged into a slender, apparently erectile, tentacle-like process which extends up in front of the head and terminates in a small ampulla. The first abdominal segment bears a pair of large swollen appendages lying at the base of the mesothoracic pair and united with a large and very prominent mid-ventral tubercle. This tubercle and its lateral appendages are represented in the *T. tessmanni* larva but the others, with the exception of the third prothoracic pair, are absent. Sections and stained, cleared preparations of the whole larva show that the various tubercles contain portions of the fatbody, at least in the bases of their cavities, and next to the hypodermis a dense, granular substance, evidently a coagulated liquid produced by the underlying adipocytes, or trophocytes. The same liquid also fills the unpaired tentacle, except its pear-shaped base, which contains fat cells. Around the bases of the tubercles are muscles so arranged that their contraction must increase the pressure on the fat and granular liquid and in all probability cause the latter to exude through the hypodermis and delicate chitinous cuticle onto the surface. The whole arrangement of the tubercles, in fact, constitutes a system of exudate organs, or exudatoria, as I shall call them, adapted to secrete substances that can be licked up by the ants when they are feeding and caring for the larvæ. In this stage the mandibles are small, soft, blunt and unchitinized so that the larva must be fed with regurgitated liquid food. The labium has a peculiar pair of fleshy appendages, shown just beneath the mandibles in *7A*. The body is naked, except for a few sparse, pointed bristles on the dorsal surface and the median pair of prothoracic appendages. As nothing like this larval stage is known among ants or indeed among the Hymenoptera, I propose to call it the "trophidium."

The second stage larva is shown in Fig. 8*A*. The various exudatoria are smaller in proportion to the remainder of the body but are still much like those of the trophidium. The body is more elliptical, the mandibles are more pointed and distinctly falcate, but even in this stage they are unchitinized and therefore nonfunctional. The coarse hairs are visible on the dorsal surface but a more uniform investment of small hairs has made its appearance. They are blunt or even clavate, especially on the prothoracic segment. In this and the trophidium stage I am unable to find any salivary glands in cleared preparations though rudiments may, perhaps, be present.

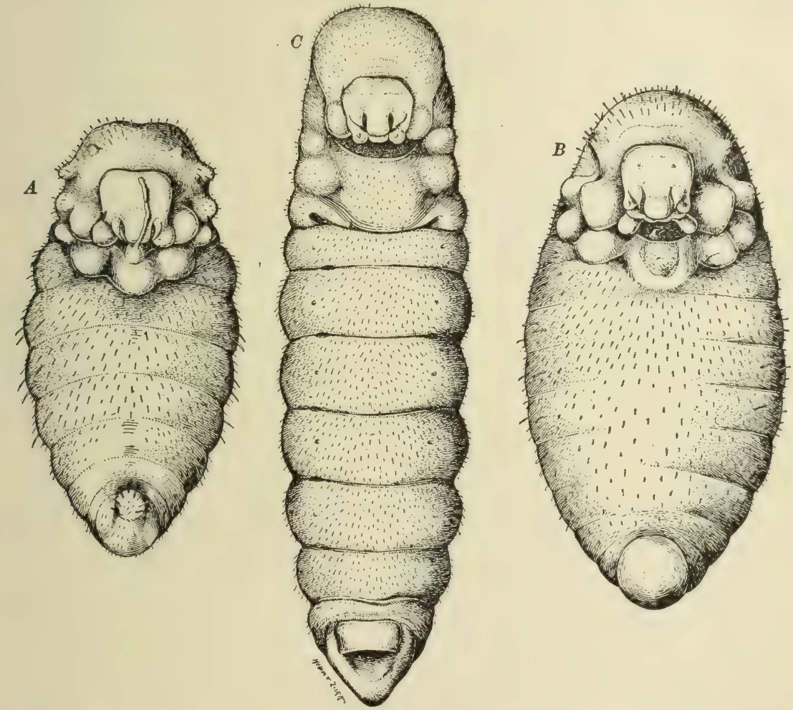

FIG. 8. *A,* second, *B,* third and *C,* fourth (adult) larval stages of *Pachysima æthiops* F. Smith.

The third stage larva (Fig. 8*B*) is larger and very regularly elliptical. The exudatoria can all be recognized, except the unpaired tentacle. It is, however, present in some of the younger individuals but in a greatly reduced and vestigial condition and at the bottom of the deep depression which now appears as a definite pocket just back of the mouth and under the midventral swelling of the first abdominal segment. In many larvæ I found in this pocket a small, rounded, dark-colored pellet, which puzzled me at first. In sections, however, it was at once seen to consist of the triturated and compacted bodies and parts of small insects. It is, in fact, a food-pellet placed by the worker ants in the pocket just behind the larva's mouth. In this stage, therefore, the larva is fed on solid food and the strongly chitinized, acute and bidentate mandibles corroborate this statement. Slender salivary glands may also be detected, indicating that the substance of the food-pellet is subjected to extraintestinal digestion. The longer hairs on the dorsal integument have almost completely disappeared. The first pair of appendages on the prothorax has disappeared and the second pair is obsolescent.

In the fourth, or adult stage (Fig. 8*C*) the larva is more elongate and cylindrical and much more hypocephalic, the prothorax forming a great protuberance in front of the head. The exudatoria are still recognizable, with the exception of the first and second prothoracic pairs, which have disappeared entirely. The labial appendages are reduced. A food pellet was found in the postcephalic pocket in several of the larvæ of this stage but is not represented in the figure. The coarse hairs have disappeared from the integument, which is now uniformly covered with very short, delicate hairs, and the structure of the posterior end of the body is very different from that of the preceding stages.

We owe the only account of the *æthiops* larva in the literature to Emery (1912). He describes what corresponds to my fourth stage larva very briefly and figures its anterior end with some of the exudatoria, but erroneously interprets the large prothoracic pair as "ébauches de pattes," or rudiments of the anterior pair of imaginal legs.[4]

The larvæ of *Pachysima latifrons* are quite as extraordinary as those of *æthiops* and also pass through four stages. The trophidium, or first stage, shown in Fig. 9, is very hypocephalic, the pro-

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[4] In the same paper Emery created the subgenus *Pachysima* for the accommodation of what was formerly called *Sima æthiops* and for a new species described as *latifrons,* because they have the frontal carinæ of the worker and female much more widely separated than in the numerous species of *Tetraponera* (*Sima auctorum*). I have raised *Pachysima* to generic rank, because the larvæ of the two species are so very different from those of *Tetraponera.*

thoracic segment being greatly enlarged and projecting anteriorly. Both preparations stained *in toto* and sections show that the portion of the fat-body in this segment is sometimes heavily charged with urate crystals, so that it undoubtedly functions as a storage kidney till the Malpighian vessels are sufficiently developed to excrete. The first and second pairs of prothoracic appendages of the *æthiops* larva are absent, but the third pair is very large and embraces the sides of the head. The meso- and metathoracic segments each bear a pair of slender pointed appendages, the first abdominal segment a huge leg-like pair, which are swollen and fusiform at the base and run out into a long slender process which forms an obtuse angle with the basal portion. The sternal region between these appendages is protuberant and its cuticular covering, like that of the four pairs of appendages is minutely prickly, unlike the smooth cuticle of the remainder of the body. Sections show that both the appendages and the sternal swelling are exudate organs, though the prothoracic and abdominal pairs are much more important than the others. The prothoracic appendages are filled with blood and very

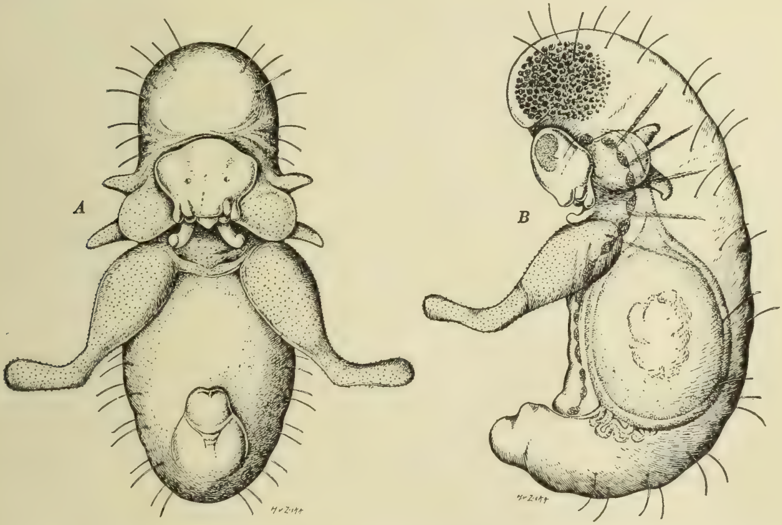

FIG. 9. First larval stage ("trophidium") of *Pachysima latifrons* Emery. *A*, ventral; *B*, lateral view.

little fat tissue, but their hypodermis is much thickened and consists of crowded cells arranged in peculiar clusters. In section the abdominal appendages appear as in Fig. 10. The fusiform base is filled with large, clear trophocytes, or fat-cells, some of which in the middle of the swelling may contain urate crystals, like those in the prothoracic storage kidney, but the slender, tubular distal portion contains a granular liquid, which can only be regarded as an exudate derived from the trophocytes in the basal enlargement. This exudate is evidently filtered through the thin cuticula covering the appendage by pressure, for there is a rather elaborate system of muscles, as in the *æthiops* larva, surrounding the bases of the appendages and capable of subjecting their contents to pressure. The head is small and has soft, blunt, rudimentary and unchitinized mandibles, and the labium bears a pair of long, palp-like appendages, which project forward in the deep depression between the head and the swollen sternal portion of the first abdominal segment. These are probably also exudatoria and seem roughly to correspond to the unpaired tentacle of the *æthiops* larva. The structure of the mouthparts shows that the larva in this stage is fed with liquid food regurgitated by the workers. The convex dorsal surface is beset with sparse, curved bristles of uniform thickness, with blunt tips. The segmentation of the body is indistinct and its posterior end curves forward and terminates in a large tubercle with the anal orifice just anterior to its base. Fig. 9*B*, drawn from a stained and cleared

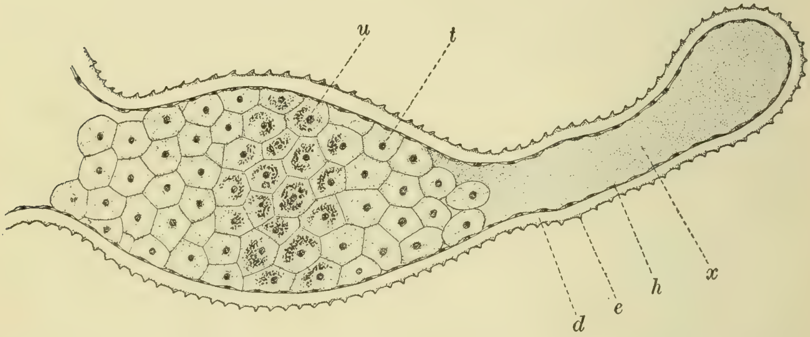

FIG. 10. Longitudinal section through exudatorium of first abdominal segment of trophidium of *Pachysima latifrons* Emery.

preparation, shows the nervous system and alimentary canal. The Malphigian vessels have only just begun to develop at the blind end of the proctenteron where it abuts on the posterior end of the large, elliptical mesenteron, or stomach, but no salivary glands can be detected.

In the second stage larva (Fig. 11*A*) the body is more elongate and cylindrical and the four pairs of appendages can still be recognized though considerably smaller in proportion to the remainder of the body. The mandibles are becoming chitinized. Many of the long hairs on the dorsal surface are still present but a general covering of short, sparse hairs has made its appearance.

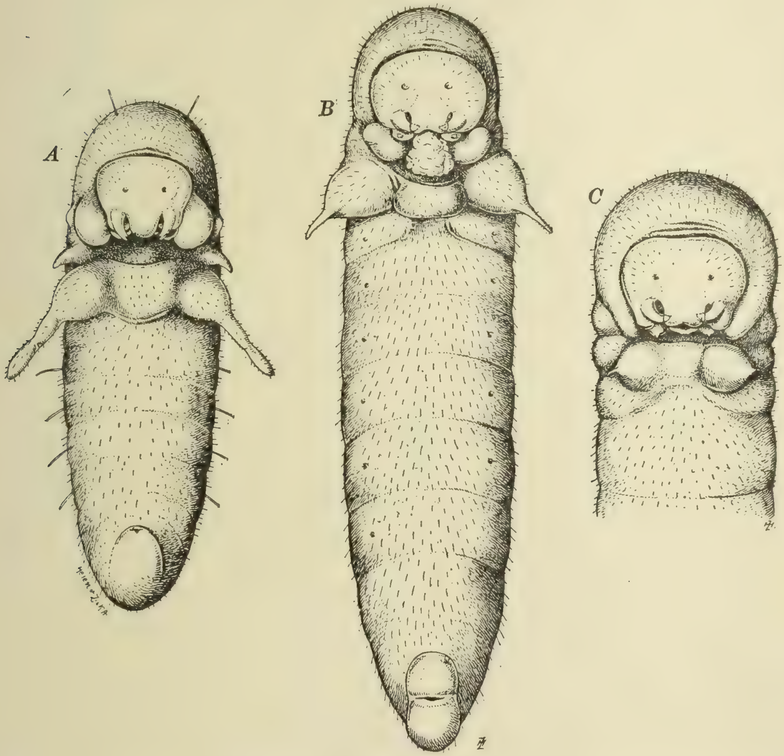

FIG. 11. *A,* second, *B,* third and *C,* fourth (adult) larval stages of *Pachysima latifrons* Emery.

The third stage larva (Fig. 11*B*) is larger and still more elongate and cylindrical and shows a further regressive development of the exudatoria. Those on the meso- and metathoracic segments have disappeared and the abdominal pair has short broad bases with the distal portions attenuated to slender points. The labial appendages have also disappeared. The mandibles are well chitinized and the larva is now fed with pellets of crushed insects, like the *æthiops* larva in the corresponding stage. These pellets were found *in situ* in several of the alcoholic specimens as represented in Fig. 11*B*. The pellet lies in the deep pocket between the head and the sternal protuberance of the first abdominal segment and is therefore within easy reach of the mandibles and labium of the larva. Cleared preparations show that the salivary glands have made their appearance, though they are small and slender.

The anterior end of the fourth stage, or adult larva is shown in Fig. 11*C*. The exudatoria of the prothoracic segment now appear merely as a pair of welts or folds embracing the sides of the head and continuous with the more dorsal portions of their segment, which is relatively smaller and less projecting than in the preceding stages. The exudatoria of the first abdominal segment are still distinct but their distal portions are reduced to mere points, sometimes absent in larvæ just before pupation, and the sternal swelling is much less prominent. In this stage the larva resembles that of *Tetraponera* throughout its various stages. In the third and fourth stages of the *latifrons* larva, as in the corresponding stages of *æthiops,* the salivary glands probably furnish secretions which are useful both in the extraintestinal digestion of the food pellet and as substances that can be imbibed by the workers. The fact that in the two species of *Pachysima* the exudatoria decline *pari passu* with the development of the salivary glands certainly suggests that both sets of organs have to some extent a common function. In forms like *Pœdalgus* and probably many other Myrmicinæ, in which the development of the salivary glands is more precocious, the exudatoria are not developed.

I believe, therefore, that we must interpret the exudatoria as very primitive glands, but they differ so much from the ordinary hypodermal glands of insects that it will be necessary to consider them more closely before proceeding further. They are, as we have seen, small diverticula like the embryonic legs, consisting of hypodermis and its overlying cuticula and containing a portion of the fat-body separated from the hypodermis by a granular liquid.[5] Now the fat-body of insects may be regarded as a diffuse ductless gland, the cells (trophocytes) of which take certain substances from the blood in which they lie, store them in the cytoplasm as fat-globules or proteid granules and later return them to the blood in a more finely divided, if not chemically modified form. The exudate which accumulates in the distal ends of the exudatoria is therefore merely blood charged with nutrient substances from the fat-cells, and either filters gradually through the hypodermis and overlying cuticle or is forced through them by muscular pressure. At first sight it would seem that the cuticle must be impervious to such a liquid, but a consideration of the more recent work on the minute structure of chitin by Holmgren (1901, 1902), Biedermann (1902, 1903), Kapzov (1911), Casper (1913) and others shows that there is nothing to prevent the passage of a thin fatty liquid, even if it were not under pressure and even if the cuticle were much thicker than it is in the ant larva. The cuticle is a colloid, either of a reticular structure, as Kapzov believes, or formed of horizontal layers of very fine fibrillæ crossing one another at an angle of 60° as most investigators, including Biedermann and Casper, maintain. Between the fibrillæ are regularly distributed and extremely fine openings or "pore canals," through which a liquid might readily pass as if the cuticle were a filter. Even in the case of the hypodermal glands fatty liquids are known to pass through the thin chitinous cuticle with which the secreting surface of the cytoplasm is always covered, even where the ends of the ducts are intracellular.

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[5] The question arises as to whether the larval exudatoria of *Pachysima* are the homologues of the true appendages on the thoracic and first abdominal segments of embryo insects. In other words, do the exudatoria represent true legs or are they new formations? The trophidium of *P. latifrons* seems to point to the former alternative. The large leg-like exudatoria on the first abdominal segment are certainly very suggestive of the embryonic "pleuropodia" to which I devoted a paper many years ago (1890). On the other hand, the four pairs of trophidium appendages in *latifrons* seem to be homologous with the four pairs of papillæ in the larva of *Bothroponera* (Fig. 4), and the latter are almost certainly merely remnants of a considerable number of similar papillæ which are scattered over the whole surface of the larval *Pachycondyla, Diacamma* and *Ponera*. Furthermore, two of the pairs of exudatoria on the prothorax of the *Pachysima æthiops* trophidium and the unpaired tentacle-like exudatorium just behind the head cannot be brought into the homology. It would seem, therefore, that the exudatoria must be regarded as cœnogenetic, or new formations peculiar to the young larvæ of certain Old World genera of Pseudomyrmini.

In this connection attention may be called to a very similar exudation of blood plasma charged with certain substances (*e. g.*, cantharidin) through the hypodermis and cuticle in many Meloid, Cantharid, Lampyrid, Coccinellid and Chrysomelid beetles. It has long been known that when these insects are roughly handled they discharge from the articulations of their legs a white, yellow or greenish, bad-smelling liquid, which Magretti (1881, 1882), Lutz (1895), De Bono (1889) and Berlese (1909) have shown to be blood plasma. It accumulates in pockets at the articulations after passing through the integument and leaving the blood cells (amœbocytes) behind, and is clearly an exudate though it is repugnatorial instead of having an alluring or nutrient function like the blood plasma of *Pachysima*.

It is unnecessary, however, to seek confirmation of my interpretation of the circumoral appendages of the *Pachysima* larva by merely pointing to the conditions in the Meloids, Coccinellids, etc. Wasmann, Holmgren and Trägårdh have published valuable studies of exudate organs much more like those of the ant larvæ. To Wasmann (1903) belongs the credit of having first made an extensive investigation of the trichome glands and exudatoria of numerous myrmecophiles and termitophiles. Many of these structures are more or less modified hypodermal glands with tenuous ducts opening at the base of hairs (trichomes) which either diffuse the secretion so that it can evaporate quickly or spread it out so that it can be readily licked up by the ants, but in such termitophiles as the Staphylinid beetle *Xenogaster inflata,* the fat-body in certain parts of the abdomen forms "blood tissue," which becomes the "exudate" by passing through a layer of hypodermis at the base of papillæ ("exudate buds").[6] The latter seem to consist of cuticular substance perforated by delicate canals that conduct the exudate to the surface. Wasman says:

> The exudate of these buds seems therefore to be a component of the blood fluid, which is as it were filtered through the hypodermal layer.

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[6] The trichome glands may be compared with similar structures in other

Some of the details in his account and figures are far from clear, but there can be no doubt about his meaning. Equally interesting is his description of the larvæ of certain symphilic myrmecophiles (*Lomechusa, Atemeles* and *Xenodusa*) concerning which he writes:

> The cuticula of the whole body, excepting the head, is membranous and whitish. Outer exudate organs (*i. e.*, trichomes) are lacking. The exudate tissue is exclusively the fat-body.

He believes, in other words, that in these larvæ the voluminous fat-body functions as a huge exudatorium which pours a fatty exudate onto the surface of the body. This at once suggests that in many ant larvæ the general fat-body may have the same function, so that there would be in these insects three possible sources of liquid substances agreeable to the worker ants. the salivary glands, the exudatoria *sensu stricto* and the fat-body. They would not all be equally developed in any given species, but at any rate there is just as much reason for supposing that the general fat-body may function as an exudate organ in the ant-larva as in the larvæ of the Lomechusine myrmecophiles. Krüger (1910) and Jordan (1913) have cleared up some of the obscurities in Wasmann's paper, especially in regard to the trichome glands of hypodermal origin, but in my opinion have not invalidated his general conclusions in regard to the role of the fat-body and blood in exudation.[7]

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animals. Many nonmyrmecophilous insects have similar glands that serve to diffuse sexually attractive secretions. The question arises as to whether many of the hair-tufts in mammals may not have an analogous function. Anthropologists seem not to have explained the retention of hairs in the axillary and pubic regions of man. It is evident that the hairs in the armpits serve rapidly to diffuse and evaporate the secretions of the sudorific glands. The pits full of trichomes on the thorax of many symphilic Paussid beetles are strangely suggestive in this connection. The function of the public hairs is not so clear, but perhaps certain bats which have peculiar tufts about the genitalia (see, *e. g.*, the figures of the Congolese *Hipposideros langi* Allen in *Bull. Amer. Mus. Nat. Hist.*, 37, 1917, pp. 436, 437) may indicate that in the remote past the pubic hairs had a sexual function in the ancestors of man.

[7] For a critique of Jordan's work and for further discussion of the structure and development of *Lomechusa* and *Atemeles* the reader is referred to Wasmann's recent monograph: "Neue Beiträge zur Biologie von Lomechusa und Atemeles" (1915).

Wasmann has shown in a number of papers that the true guests of termites, the symphiles, are physogastric, *i. e.,* have the abdomen enormously distended with fatty tissue. This condition is very striking in certain Staphylinids (*Xenogaster, Corotoca, Spirachtha, Termitomimus,* etc.) and Diptera (*Timeparthenus, Termitomyia, Termitoxenia, Thaumatoxena,* etc.). Trägårdh (1907) has studied sections of the beetle *Termitomimus,* which lives in considerable numbers in the *Eutermes* colonies of Zululand. His description of the exudate organs is so much clearer than Wasmann's and so significant in connection with my account of the *Pachysima* larvæ, that I quote the greater part of it:

> The relation of the fat-body to the hypodermis and the cuticle is different in different parts of the body.
>
> 1. The hypodermis is exceedingly thin, sometimes scarcely discernible and pressed close to the cuticle by the underlying fat-body. The cuticle has no distinct endostracum and is penetrated by an immense number of extremely fine pores, arranged in transverse rows. This is the case with the ventral, lateral and posterior part of the pseudoabdomen, *i. e., exactly where the cuticle is of a bright reddish-yellow color* ("symphilous color" Wasmann) *and where the termites may most easily get access to it.*
>
> 2. The hypodermis is thick and withdrawn from the cuticle which is thicker, with well-developed epiostracum and endostracum, leaving a rather wide space, which is filled with liquid. . . . The fat-body is contiguous to the hypodermis. The space between the cuticle and the hypodermis is more or less filled with a cyanophilous tissue of a spongy appearance which sometimes exhibits a very distinct radial structure, sometimes is concentrically stratified and contains numerous granules which are also to be found in the trichogenic cells. This is evidently a fluid, which has either passed through the hypodermis and is a derivate from the fat-body or it is a secretion produced by the hypodermis and is coagulated by the method of fixation. . . .
>
> The above stated facts concerning the relation of the fat-body to the hypodermis and the cuticle differ in some essential respects from what Wasmann has found in the termitophilous physogastrous insects studied by him. In *Spirachtha, Termitoxenia,* the larvæ of *Orthogonius* and *Glyptus,* in *Xenogaster* and other Aleocharini the hypertrophied fat-body is always surrounded by large tracts of blood-tissue, consequently the exudation is derived directly from the blood-tissue and only indirectly from the fat-body. The exudation is no fluid but evaporates through the membranous cuticle, which has no pores.
>
> To support the theory of the exudation being only an attractive odor and not offering the termites any source of subsistence Wasmann points out the fact that the symphili as a rule only occur in small numbers in the nests.
>
> These statements, however true they may be with regard to the above mentioned genera, do not apply at all to *Termitomimus.* In this genus on the

> contrary, in the part of the abdomen which is easiest accessible to the termites, viz., the ventral, lateral and posterior side of the pseudoabdomen,
>
> 1. The fat-body is not surrounded by the blood-tissue but contiguous with the extremely thin hypodermis and
> 2. The cuticle is penetrated by an immense number of pores (and the endostracum is not distinctly discernible).
> 3. Furthermore *Termitomimus* does occur in great numbers in the nests of the termites.
>
> These facts seem to me to suggest that in *Termitomimus* the fat itself or a derivate of the fat-body may possibly be secreted *as a fluid* through the numerous pores of the cuticle and not merely evaporate and that *Termitomimus* thus offers to the termites a source of subsistence. The comparatively very large extension of the area of the cuticle which exhibits this structure also argues in favor of this theory.

In another paper (1907*a*) Trägårdh describes a peculiar Tineid caterpillar with exudatoria even more like those of the *Pachysima* larva. He found it in the tree nests of *Rhinotermes* in Zululand. The relations between the caterpillar, which feeds on the woody substance of the nest, and the termites are evidently friendly.

> When disturbed, the larvæ were seen to make their way to other parts of the nest, coming along one after the other, with regular intervals, like in a procession, each larva being escorted by a few soldiers and workers.

Each of the seven anterior abdominal segments of the caterpillar bears on its sides a pair of long, tapering appendages, which Trägårdh regards as exudatoria and each appendage contains a lobe of the fat-body, surrounded by blood. The imperforate hypodermis is separated from the thin cuticle, the space between being filled with exudate. In this case he believes that the exudate must evaporate on the surface of the body, since he says:

> As the larva emits a strong odor, and the termites were scarcely seen touching the appendages, the exudation is very likely an alluring odor.

He compares the organs with the various osmateria described by Packard in the caterpillars of *Megalopyge* and Hemileucidæ.

Certain organs in the larvæ of two groups of Hymenoptera may also be interpreted as exudatoria. In 1907 I called attention to peculiar blister-like organs on the sides of pseudonymphs of certain Eucharine parasites of ants, notably in *Orasema*. These structures are shown in Figs. 19 and 21, Pl. 2 of the paper referred to and in Fig. 251 *F, G,* p. 415 of my ant book (1910). In the pupa of the same insect the abdomen has similar organs in the form of transverse welts. Reichensperger (1913, Pl. 6, Fig. 12) describes and figures the very same organs in an Abyssinian Eucharine, *Psilogaster fraudulenta,* which lives with *Pheidole megacephala,* and suggests that they may be exudate organs. Forel (1890) had previously mentioned similar structures ("asperités et boussoufflures") on the pupa of the large *Eucharis myrmeciæ* taken from the cocoon of an Australian bulldog ant, *Myrmecia forficata.* On recently reëxamining my preparations I find that the organs of *Orasema viridis* may be interpreted as exudatoria. They are knob-shaped, with very thin hypodermis and cuticle and are filled with blood but contain no fat-tissue, although the fat-body in the abdomen and thorax is very voluminous. In life the knobs are colorless and glistening. Both the pseudonymphs and pupæ are assiduously licked by their host, *Pheidole instabilis,* so that the knobs of the former and the welts of the latter probably produce substances agreeable to the ants.[8]

The other group of Hymenoptera comprises the singular South African bees of the genus *Allodape.* In 1902 Brauns showed that they make very primitive nests, consisting of a single cavity, often 12 cm. long, in the stems of various Liliaceous plants, but unlike all other solitary bees, feed their larvæ from day to day with "Futterbrei" (honey-soaked pollen?). In the warmer portions of Cape Colony and German Southwest Africa *Allodape* breeds throughout the year. The single cavity of the nest contains eggs, larvæ in all stages, pupæ and freshly emerged bees intermingled. The larvæ are unique among bees in possessing peculiar tubercles on the sides of the fifth to tenth segments. Friese (1914) publishes photographs of some rather shrivelled half-grown larvæ and describes the tubercles as "bladderlike evaginations of the outer skin." Brauns seems to regard them as legs (pseudopods) and says that they are used to hold the food, but it seems probable that they are really exudate organs. If this proves to be true, the resemblance of *Allodape* to *Pachysima,* which also rears its brood in all stages in hollow stems and feeds the older larvæ with food-pellets, would be very striking. *Allodape* is also of considerable interest in connection with Roubaud's observations on the wasp *Synagris* which will be considered in the sequel.

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[8] While this paper was in the hands of the printer Dr. R. J. Tillyard of New South Wales sent me the larvæ, pupæ and an adult male of a huge undescribed Eucharine, which he found attacking the brood of the red bulldog ant (*Myrmecia gulosa*). Prof. C. T. Brues believes that the parasite may belong to the genus *Psilogaster* and will describe it in the near future. The larvæ and pupæ are covered with exudatoria like those of *Orasema* but more prominently developed.

More important in their bearing on the exudate organs of *Pachysima* are Holmgren's observations on the termites. He devotes the twelfth chapter of his volume (1909) on the anatomy of these insects to the exudate tissue. Termites are really themselves physogastric like their guests, and Holmgren shows that all the castes, but especially the queens, have extensive exudate tissues, consisting of the peripheral layers of the abdominal fat-body. In these layers the trophocytes do not contain fat-globules but numerous minute granules which are discharged into the blood and thus convert it into the exudate that passes through numerous pores or lacunæ in the chitinous cuticle to the surface. There it is licked up by other members of the colony. He finds that the development of the exudate tissue differs considerably not only in the different castes but also in their various developmental stages and

> that the intensity of the licking and feeding of the individuals of a termite colony is directly proportional to the amount of their exudate tissue. Those with the largest mass of exudate tissue are the best fed and the most licked. In other words, the care bestowed by the workers on the various members of the colony is not an immediate expression of an altruistic philoprogenitive instinct (Brutpflegeinstinct), but depends essentially on egoistic motives, *i. e.,* exudate hunger.

To this point I willingly follow Holmgren, but both he and Wasmann have used their respective observations as a basis for what seem to me to be rather dubious speculations, a consideration of which will have to be deferred till the more general part of my discussion is reached.

Escherich (1911) gives a more vivid, not to say more spectacular account of the exudate hunger of termites. So eager are the workers of the Ceylonese *Termes redemanni* for the exudate of their huge physogastric queen that they actually tear little strips out of her cuticle in order to get at the liquid more readily! Escherich found that old queens sometimes have their white abdomens dotted with the small brown scars of the wounds thus inflicted by their progeny. Here the feeding behavior of the mother and offspring is the reverse of that in incipient ant colonies, since the queens are fed with regurgitated food by the workers and feed the latter with exudates, but this is, in all probability, also the case in established ant colonies when the workers have matured and the queen no longer feeds the brood.

The facts collated in the foregoing paragraphs relate to the exudate organs, but we had previously seen that the salivary glands of larval ants probably subserve a similar function in the life of the colony in addition to digesting proteid foods extraintestinally and producing silk at the time of pupation. The question arises as to whether there is any evidence that in other groups of social insects the salivary glands of the larva produce substances which are consumed by the worker nurses. Fortunately there are some very pertinent observations at hand in the French literature which is so rich in splendidly original works on the habits and taxonomy of insects. The observations to which I refer relate to the social wasps. Du Buysson (1903) observed that the larvæ of *Vespa* "secrete from the mouth an abundant liquid. When they are touched the liquid is seen to trickle out. The queen, the workers and the males are very eager for this secretion. They know how to excite the offspring in such a way as to make them furnish the beverage." And Janet (1903) was able to prove that the secretion is a product of the salivary, or spinning glands and that it flows from an opening at the base of the labium. "This product," he says, "is often imbibed by the imagines, especially by the just emerged workers and by the males, which in order to obtain it, gently bite the head of the larva."

The most illuminating study of this matter, however, is found in a fine paper by Roubaud on the wasps of Africa (1916). His account of the primitive wasps of the genus *Belonogaster* presents a striking picture of one of the earliest stages in the social life of wasps, as will be seen from the following quotation:

> In the species of *Belonogaster* as well as in those of the genera *Icarià* and *Polistes* we have been able to observe this proceeding in detail. All the larvæ, from birth, secrete from a projection of the hypopharynx, on the inferior surface of the buccal funnel, an abundant salivary liquid, which at the slightest touch spreads over the mouth in a drop. All the adult wasps,

males as well as females, are extremely eager for this salivary secretion, the taste of which is slightly sugary. It is easy to observe, especially in *Belonogaster,* the insistent demand for this larval product and the tactics employed to provoke its secretion.

As soon as a nurse wasp has distributed her food pellet among the various larvæ, she advances with rapidly vibrating wings to the opening of each cell containing a larva in order to imbibe the salivary drop that flows abundantly from its mouth. The method employed to elicit the secretion is very easily observed. The wing vibrations of the nurse serve as a signal to the larva, which, in order to receive the food, protrudes its head from the orifice of the cell. This simple movement is often accompanied by an immediate flow of saliva. But if the secretion does not appear the wasp seizes the larva's head in her mandibles, draws it towards her and then suddenly jams it back into the cell, into which she then thrusts her head. These movements, involving as they do a stimulation of the borders of the mouth of the larva, compel it to secrete its salivary liquid.

One may see the females pass back and forth three or four times in front of a lot of larvæ to which they have given nutriment, in order to imbibe the secretion. The insistence with which they perform this operation is such that there is a flagrant disproportion between the quantity of nourishment distributed among the larvæ by the females and that of the salivary liquid which they receive in return. There is therefore a real exploitation of the larvæ by the nurses.

The salivary secretion may even be demanded from the larva without a compensatory gift of nourishment, both by the females that have just hatched and by the males during their sojourn in the nest. The latter employ the same tactics as the females in compelling the larvæ to yield their secretion. They demand it especially after they have malaxated an alimentary pellet for themselves, so that there is then no reciprocal exchange of nutritive material.

It is easy to provoke the buccal secretion of the larvæ artificially. Merely touching the borders of the mouth will bring it about. The forward movement of the larvæ at the cell entrance, causing them to protrude their mouths to receive the food pellet, is also easily induced by vibrations of the air in the neighborhood of the nest. It is only necessary to whistle loudly or emit shrill sounds near a nest of *Belonogaster* to see all the larvæ protrude their heads to the orifice of the cells. Now it is precisely the vibrations of the air created by the rapid agitation of the bodies of the wasps and repeated beating of their wings that call forth these movements, either at the moment when food is brought or for the purpose of obtaining the buccal secretion which is so eagerly solicited.

Roubaud summarizes the general bearing of his observations in the following paragraph:

The reciprocal exchange of nutriment between the adult females and the larvæ, the direct exploitation of the larval secretion without alimentary compensation by the males and just emerged females are trophobiotic phenomena the elucidation of which is of great importance to an understanding of the

> origin of the social tendencies in the Vespidæ, as we shall show in the sequel. The retention of the young females in the nest, the associations between isolated females, and the coöperative rearing of a great number of larvæ are all rationally explained, in our opinion, by the attachment of the wasps to the larval secretion. The name *œcotrophobiosis* (from οἰκος, family) may be given to this peculiar family symbiosis which is characterized by reciprocal exchanges of nutriment between larvæ and parents, and is the *raison d'être* of the colonies of the social wasps. The associations of the higher Vespids has, in our opinion, as its first cause the trophic exploitation of the larvæ by the adults. This is, however, merely a particular case of the *trophobiosis* of which the social insects, particularly the ants that cultivate aphids and coccids, furnish so many examples.

It does not seem to me that the term "œcotrophobiosis" is aptly chosen. Apart from its length, it implies, as Roubaud states, a relationship between adult and larval members of the same colony or family, comparable with that existing between ants on the one hand and Aphids, Coccids, Membracids and Lycænid larvæ on the other. This relationship, however, is, so far as nutrition is concerned, one-sided since the ants exploit the aphids, etc., and may defend or even transport them, but do not feed them. Moreover, even in *Belonogaster* the feeding of adults and larvæ is reciprocal, and the latter could not be reared if they were actually exploited to such an extent as to interfere with their growth. As the relationship is clearly coöperative or mutualistic, I suggest the term *trophallaxis* (from τροφή, nourishment and ἀλλάττειν, to exchange) as less awkward and more appropriate than "œcotrophobiosis."

That the feeding of the young by the mother wasp without compensation is more primitive than the condition in *Belonogaster* is shown by Roubaud's beautiful observations (1908, 1910, and 1916) on three species of *Synagris* in the Belgian Congo (*callida, sicheliana* and *cornuta*). These wasps represent important stages in the transition from the solitary to the social forms, since they make earthen cells like other Eumenids, lay eggs in them and provide the young with paralyzed caterpillars of Hesperid butterflies. In favorable seasons, when caterpillars are bundant, the behavior is like that of our northern Eumenid and Odynerid wasps, numerous small or single large caterpillars being placed with the egg in the cell and the latter sealed up ("approvisionnement massif accéléré"), but when the season is less unfavorable and food scarcer, the wasp's activities slow down so that the larva may hatch before all the prey is brought in ("approvisionnement massif ralenti"). This condition leads naturally to a feeding of the larva from day to day with living but paralyzed caterpillars ("éducation surveillée indirecte") and eventually to a stage essentially like that of the social wasps in which the caterpillar is chewed up and placed as a pellet in the mouth of the larva ("éducation surveillée directe"). *Synagris cornuta* has reached this last stage. The mother insect, while malaxating the caterpillar, herself imbibes its juices.

> The internal liquids having partly disappeared during this process of malaxation, the prey is no longer, as it was in the beginning, soft and juicy and full of nutriment for the larva. It is possible, in fact, to observe that the caterpillar patée provided by the *Synagris cornuta* is a coarse paste which has partly lost its liquid constituents. There is no exaggeration in stating that such food would induce in larvæ thus nourished an increase of the salivary secretion in order to compensate for the absence of the liquid in the prey and facilitate its digestion.

It is here that the further development to the condition seen in *Belonogaster* and other social wasps sets in. The mother wasp finds the saliva of the larva agreeable and a trophallactic relationship is established. As Roubaud says,

> the nursing instinct having evolved in the manner here described in the Eumenids, the wasps acquire contact with the buccal secretion of the larva, become acquainted with it and seek to provoke it. Thence naturally follows a tendency to increase the number of larvæ to be reared simultaneously in order at the same time to satisfy the urgency of oviposition and to profit by the greater abundance of the secretion of the larvæ.

Although considerable evidence thus points to trophallaxis as the source of the social habit in wasps, ants and termites, it must be admitted that the phenomenon has not been observed in the social bees. That the latter may have passed through a phylogenetic stage like that of *Synagris* seems to be indicated by the solitary bees of the genus *Allodape* to which I have already referred (p. 318). Brauns' observations, though meager, show nevertheless that *Allodape* has reached Roubaud's fourth stage, that of direct feeding of the larvæ from day to day, and if I am right in supposing that the peculiar appendages of the larvæ are exudate organs, there would be grounds for assuming that trophallaxis occurs in this case. On the other hand, it has often been suggested (*e. g.*, by von Buttel-Reepen) that the three social subfamilies, the stingless bees (Meliponinæ), bumble-bees (Bombinæ) and honey bees (Apinæ) have developed from the solitary bees by another and more direct path, for the Meliponinæ, though living in populous societies, still bring up their brood in essentially the same way as the solitary bees, *i. e.*, by sealing up the eggs in cells provisioned with honey-soaked pollen. The Bombinæ, however, keep opening the cells from time to time and giving the larvæ a little food at a time, and in the honey bee the cells are left open till pupation and the larvæ fed more continuously. Numerous facts indicate that the Bombinæ are the most primitive, the Apinæ the most specialized of existing social bees, and that the Meliponinæ, though closely resembling the solitary bees in the care of the young, are nevertheless in other respects very highly specialized (vestigial sting, elaborate nest architecture, etc.). It is therefore not improbable that these bees, after passing through a stage more like that of the Bombinæ, have reverted secondarily to a more ancient method of caring for their brood. At any rate, the Meliponinæ have been so little studied, as compared with the Bombinæ and Apinæ, that they can be left out of the present discussion. Sladen (1912) has given us a good account of the queen bumble bee feeding the larvæ, but he says nothing about the salivary glands of the latter. These are very large, as we know from the work of Bordas (1894), but their development is perhaps fully accounted for by the complete cocoon spun by the mature larva. Even in the honey bee, which has been so thoroughly studied, I find no evidence that the adult workers feed on larval secretions. In both cases, however, it is impossible under natural conditions accurately to observe the behavior of the larva while it is being fed. This might, perhaps, be done if the bees could be induced to rear their young in glass tubes made to resemble the cells.[9] But even if it should be found, on further investigation, that there is no indication of reciprocal feeding between the larval and adult Bombinæ and Apinæ, we might still contend that these very highly specialized insects had in their evolution passed far beyond the stages represented by the termites, ants and social wasps. There can, indeed, be little doubt that the bees are descended from wasp-like ancestors and that they must therefore have passed from an animal to a vegetable diet. If the change of diet took place after the social habit had been established, as is possible and as is so clearly shown to be the case in the harvesting and fungus-growing ants, the loss of a resort to the larval secretions by the adult social bees could be readily explained as due to the abandonment of a scarce animal food, procured with considerable difficulty, for nectar and pollen, which are abundant and easily obtained.

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[9] Dr. E. F. Phillips informs me that it would be possible to observe the behavior of honey-bee larvæ and their nurses in cells built against and partly formed by the glass wall of an observation hive.

Another objection that may be urged against the view that trophallaxis is so fundamental as I contend, is the behavior of the ants towards their inert pupæ, which though transported and defended as assiduously as the larvæ, yield neither liquid exudates nor secretions. This does not seem to me to be a serious objection, because the pupæ evidently have an attractive odor and may therefore be said to produce volatile exudates like certain myrmecophiles. Both the larvæ and pupæ, moreover, evidently represent so much potential or stored nutriment available for the adult ants when the food-supply in the environment of the colony runs very low or ceases entirely. Infanticide and cannibalism then set in with the result that the devouring of the young of all stages may keep the adult personnel of the colony alive till the trophic conditions of the environment improve. Certain predatory tropical species (Dorylinæ, Cerapachyini) regularly raid the colonies of other ants and carry home and devour their brood. In northern Eurasia and North America *Formica sanguinea* makes similar raids on colonies of *Formica fusca* but permits a certain number of the pupæ to hatch and become "slaves." The latter, however, represent only a small portion of the pupæ secured during the course of the summer. Wasmann believes that the *fusca* pupæ are plundered for the sake of being reared. This I doubt, but if true, we should have to account for it by supposing that to the *sanguinea* workers the odor of the *fusca* pupæ is, if anything, even more attractive than that of their own.

If we confine our attention largely to the ants, I believe it can be shown that trophallaxis, originally developed as a mutual trophic relation between the mother insect and her larval brood, has expanded with the growth of the colony like an ever-widening vortex till it involves, first, all the adults as well as the brood and therefore the entire colony; second, a great number of species of alien insects that have managed to get a foothold in the nest as scaven- *i. e.,* other species of ants (social parasitism) ; fourth, alien insects gers, prædators or parasites (symphily) ; third, alien social insects, that live outside the nest and are "milked" by the ants (trophobiosis), and, fifth, certain plants which are visited or sometimes partly inhabited by the ants (phytophily). In other words the ants, have drawn their living environment, so far as this was possible, into a trophic relationship, which, though imperfect or one-sided in the cases of trophobiosis and photophily, has nevertheless some of the peculiarities of trophallaxis. A brief sketch of each of these five expansions, indicated as annular areas in the accompanying diagram (Fig. 12), may not be out of place.

1. There is a very close resemblance between the behavior of adult ants towards one another and their behavior towards their young. The adults feed one another with regurgitated food or even with secretions as is the case with *Crematogaster* (*Physocrema*) *inflata,* an Indomalayan species, the workers of which have great sugar-glands in the back of the thorax. Many ants transport each other, and the transported ant assumes a quiescent, larval or pupal attitude. This is best seen in certain Ponerinæ, *e. g.,* in the species of *Lobopelta,* which carry their males under the body as if they were larvæ or pupæ. On such occasions the males keep their legs and antennæ in the pupal position. Moreover, when the food-supply of the colony is cut off ants often devour other ants of the colony as if they were larvæ or pupæ. The largest workers (soldiers) are eliminated first, either because they represent more stored food or because their continued life in the colony constitutes a greater drain on the food resources, or for both reasons. Some years ago I recorded an instance of this behavior in an Arizona ant, which I called *Pheidole militicida,* because it regularly kills and eats all the large-headed soldiers in the colony during the winter when the food supply is very limited. In artificial nests of *Camponotus,* which has poly-

morphic workers, a similar elimination of the largest individuals may be observed when the colony is left long without food.

2. Among myrmecophiles and termitophiles Wasmann has shown that there are certain species (symphiles) that have trophallactic relations with their hosts. Among ants especially these relations are so intimate that the symphiles may be regarded as integral members of the colony. The adult Lomeschusine beetles, *e. g.,* are not only fed and licked, but their young are treated as if they were ant larvæ, owing to the presence of trichome glands ("external exudate organs" of Wasmann) in the former and fatty, or internal exudatoria in the latter.

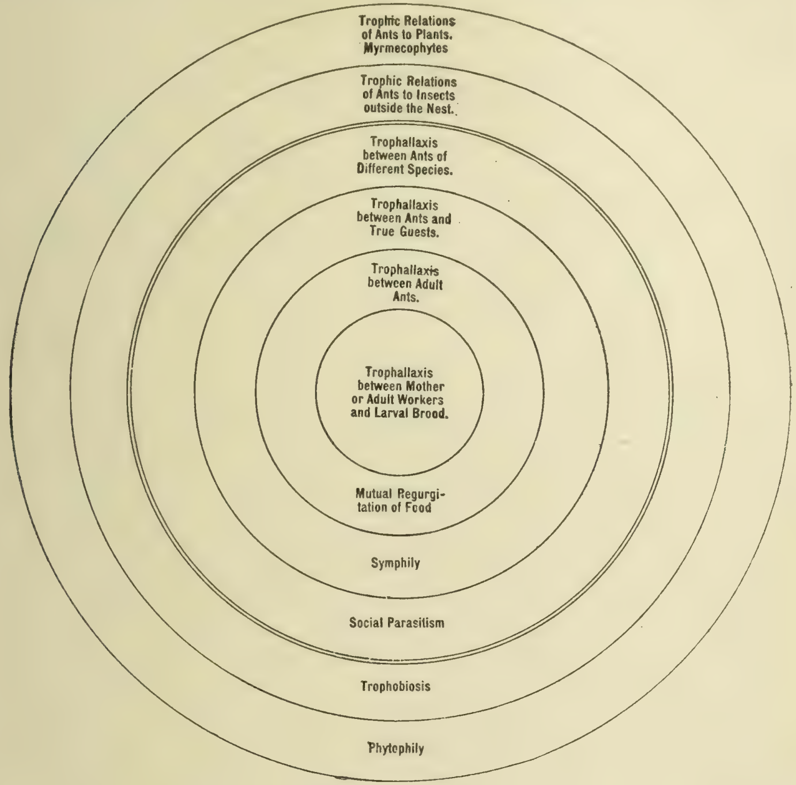
Trophic Relations of Ants to Plants. Myrmecophytes
Trophic Relations of Ants to Insects outside the Nest.
Trophallaxis between Ants of Different Species.
Trophallaxis between Ants and True Guests.
Trophallaxis between Adult Ants.
Trophallaxis between Mother or Adult Workers and Larval Brood.
Mutual Regurgitation of Food
Symphily
Social Parasitism
Trophobiosis
Phytophily

FIG. 12 Diagram to illustrate the expansions of the trophallactic and trophic relationships within and outside the ant colony. The confines of the nest are indicated by the double line.

3. The various parasitic ants, of which a number of species have come to light within recent years and have been described by Wasmann, Donisthorpe, Emery, myself and others, can be shown to have established trophallactic relations with their host species. One of the most instructive is *Leptothorax emersoni* which lives with *Myrmica canadensis.* I have described its habits and those of one of its subspecies in three of my former papers (1901, 1903, 1907).

4. The relations of ants to plant-lice and other Homoptera and to the larvæ of Lepidoptera outside the nest are, as I have said, *in*completely trophallactic, since these insects are not fed, though they may be defended by the ants. The Homoptera are not fed probably for the simple reason that their mouthparts are so peculiarly specialized for piercing plant-tissues and sucking their juices, and the Lepidopteron larvæ have, as a rule, no occasion to abandon their leaf diet. There are, however, several cases in which both caterpillars and Homoptera have entered into more intimate association with the ants. Many of the root aphids and coccids and their eggs are collected and kept by the ants in their nests, at least during certain seasons of the year. Two of the caterpillars that have acquired closer relations with the ants are so instructive, as illustrating one of the ways in which the myrmecophilous habit has been developed, that they merit more detailed description.

F. P. Dodd (1912) found that the first-stage larva of a small gray Queensland moth, *Cyclotorna monocentra,* is ectoparasitic on a Jassid Homopteron which feeds on certain trees and is attended and "milked" by an ant of the genus *Iridomyrmex.* The ant carries the parasite but not the Jassid into its nest. There the former spins a temporary cocoon and later emerges from it as a peculiar, flat, bright red (symphilic color), second stage larva, with two long tails. In this stage it subsists "solely on the ant grubs by sucking out their juices," but as in the case of *Lomechusa* in the nests of the European *Formica sanguinea,* the ant is partially recompensed for the loss of its brood. Dodd says:

> Reference has been made to the caterpillars raising their terminal segments, even the small ones from the cocoons doing so. This was quite sufficient to warrant investigation. Consequently at various times I have placed them with ants and grubs under glass, in order that they could be seen to advantage and without risk of disturbance. When the anal parts are pro-

> truded, an ant generally soon becomes aware of the fact and will be seen to pay these great attention. I soon noticed that a liquid, often perfectly transparent (it looks so on the blue-green ground, probably was pale bluish), is emitted, and that it is greedily drunk up by the ants. Over and over again, with and without a lens, I have seen this issue, and the ants speedily absorb it. Some ants, perhaps hungry or more enterprising than others, would take in a supply from a second caterpillar. If an ant is not satisfied with the quantity given out, she deliberately seizes the protruding parts and gives them a gentle nip, the mandibles can plainly be seen to press upon the juicy flesh; if the hint is not immediately acted upon a more vigorous squeeze is given, and the tails may be gripped and pressed. This is very comical, the ant's meaning is unmistakable and the caterpillar so thoroughly understands it, too, for a second hint never fails. This liquid, though frequently quite clear, is often mixed with yellowish matter, and at times some jelly-like substance is extruded; the latter the ants do not care about, for after the moisture is licked up this is in their way, and if they have not been imprisoned too long, will seize and tug at it until it comes off, and carry it to a spot set apart for waste matter, such as their own pellets and pupal skins, etc., are kept in.

Dodd also observed the ants licking and cleaning the caterpillar and the caterpillar cleaning the ants! When mature the caterpillar leaves the nest, travels to the nearest tree in company with the foraging ants, spins its cocoon in a crevice of the bark and pupates. In about twenty days the moth emerges.[10]

The second case is the caterpillar of *Lycæna orion,* which has been recently studied by Chapman (1916, 1916*a*) and Frohawk (1916) in England. The butterfly lays its eggs on thyme and other plants. On these the larva feeds, and is often attended by ants as it possesses a honey-gland like many other larval Lycænids. When it has reached the third, or last moult it crawls down to the ground and on encountering a foraging worker of *Myrmica lævinodis* or *scabrinodis* hunches up the anterior segments of its body in a singular manner. Frohawk interprets this behavior as a "signal" which induces the ant to seize the caterpillar and carry it into the nest.

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[10] When I was in Queensland Dodd generously gave me a fine series of all the stages of this extraordinary insect, together with specimens of its host ant. The latter, which I had previously found regularly nesting in the superficial portions of large, flat termitaria at Koah and Townsville, is not, as Dodd states in his paper, *Iridomyrmex purpureus* Smith (= *detectus* Smith), but *I. sanguineus* Forel. It is smaller and paler than *detectus*, but every bit as fierce and aggressive.

> The individual ant which first finds the larva is always the one to carry it off. Although during its attendance several other ants may find the larva and stay by it a short time, and even milk it, they soon leave it to its original attendant, who apparently informs them that their services are not needed. [!] Whether the ant signals to the larva for it to prepare itself for transit, or the larva gives the signal that it is ready to be taken, seems doubtful; but from what we have seen both Capt. Purefoy and I are inclined to think that the larva gives the signal. No. 3 larva alluded to hunched itself both the second and third time while the ant was about an inch away and facing an opposite direction, and at the fourth hunching up the ant was standing over the larva ready for the signal, and when this was given it was quickly seized and carried.

Chapman observed that after the caterpillar was taken into the nest it fed on the *Myrmica* larvæ. During this period of its life it was not seen to yield the secretion of its honey-gland but was treated by the ants as what Wasmann would call an indifferently tolerated guest, or synœkete.

5. The fifth expansion of trophallaxis, namely the acquisition of trophic relations with the myrmecophytes, or plants possessing extra-floral nectaries or food-bodies, is also imperfect like ordinary trophobiosis, since the ants merely obtain nutriment from the plants and possibly afford them some protection. The nectar and other plant-foods are for the purposes of the ants merely so many exudates like the excrement of the Homoptera (honey-dew) and the sweet secretions of the Lycænid caterpillars which feed on the foliage.

As the foregoing study of trophallaxis has an important bearing on Wasmann's and Holmgren's interpretation of symphily it will be advisable to consider their views in greater detail. Wasmann has elaborated his ideas in regard to the origin and meaning of symphily in several papers, but as an article published in 1910 embodies his mature and apparently final contentions, his earlier publications need not be drawn into the discussion. Having found that particular symphiles live only with particular host ants and termites, he concludes, first, that the latter have during their phylogeny acquired particular symphilic instincts as differentiations or modifications of their original nursing and adoptive instincts, and second, that the true ant and termite guests have been developed by these symphilic instincts through a process called "amical selection," which he likens to the conscious artificial selection employed by man in perfecting the numerous, often bizarre varieties among his domesticated animals and plants. Escherich (1898, 1902, 1911), Schimmer (1909, 1910) and I (1910) have never accepted this view, and I am still unable to see that Wasmann has successfully disposed of our arguments. The whole matter comes down to the answers to two questions: Do ants and termites possess special symphilic instincts? and: Is the assumption of amical selection necessary to account for the facts? In my opinion both questions are to be answered in the negative.

It is unnecessary to consider all the various symphiles which Wasmann has so long and so carefully studied. A brief account of *Lomechusa strumosa,* his chief battle-horse and according to his own statement one of the most typical of symphiles, will suffice. This is admittedly a predatory parasite in the colonies of *Formica sanguinea.* Its larvæ devour the ant larvæ and the adult beetles are fed and licked by the ants. The fat tissue of the larva probably supplies the ants with an agreeable exudate and the adults certainly furnish an agreeable secretion from their abdominal trichome glands. When the larvæ, which are evidently treated as if they were ant larvæ, mature, they are buried in the soil, just as the ant-larvæ are buried, in order that they may pupate. The pupæ are also unearthed like the ant pupæ, after they have spun their cocoons, but this treatment is fatal to the parasites and only those that have been forgotten and left in the soil are able to develop into beetles. Often the greater part of the ant brood is destroyed by the *Lomechusa* larvæ, but in some colonies, by a process which Wasmann has never adequately explained, many of the larvæ develop into pseudogynes, or forms intermediate between workers and females. These pathological individuals are unable to perform the functions of either of the castes which they imperfectly represent. This is in its essential outlines the history of *Lomechusa.* Now Wasmann believes that *Formica sanguinea* has acquired during its phylogeny a special symphilic instinct which impels it to foster *Lomechusa* to the detriment of the colonies and therefore to the detriment of the species, and regards the case as furnishing a splendid argument against natural selection and an incontestible proof of the existence of amical selection. The same reasoning is, of course, made to apply, *mutatis mutandis,* to *Claviger testaceus* which lives with *Lasius flavus,* the Paussids which live with different species of *Pheidole,* the physogastric Staphylinids which live with various termites, etc. The bizarre structures of these symphiles, such as the antennæ of Clavigerids and Paussids, are compared with the deformities of some breeds of domestic animals and are supposed to have arisen and to have been perfected in an analogous manner. The analogy, as conceived by Wasmann, is indeed so close that it is hard to see why the term amical selection should have been introduced for what would seem to be after all only another case of Darwin's artificial selection though performed by ants instead of men.

The argument looks plausible till we examine it more critically. When we ask how the particular symphilic instinct to foster *Lomechusa* became established *i. e.,* hereditary, in *sanguinea,* we see that Wasmann has taken a great deal for granted. Of course, we really know nothing about the phylogeny of *sanguinea* in its relation to *Lomechusa.* The *sanguinea* queen and her fertile female offspring in colonies that are old enough to be infested by the beetle, pay no particular attention to the parasite and could therefore acquire such an instinct as Wasmann postulates only by inspiration. The workers, which do look after the beetles, rarely reproduce and probably never reproduce in infested colonies and would therefore not be in a position to transmit even if they acquired such an instinct. And as the *sanguinea* brood is either largely devoured or converted into infertile pseudogynes, so that the whole colony tends to die out, we have anything but a favorable environment for engendering and transmitting an instinct so specialized as to be concerned with a particular symphile. Furthermore, *Lomechusa* is a very sporadic parasite. It may be abundant in certain regions, as in certain parts of Holland, where Wasmann has worked and at St. Moritz, in the Upper Engadin of Switzerland where I once found it and its larvæ in considerable numbers, but there are many regions in which the *sanguinea* colonies are entirely free from the pest and hence in a flourishing condition and one most favorable to the survival of the species. Wasmann has not shown that *Lomechusa* introduced into the colonies of such regions is treated with any less consideration than in young, previously uninfested colonies in regions where the parasite is common. As *Lomechusa* is very rare in England, the experiment could be readily performed by shipping a lot of the beetles from the continent to my friend Donisthorpe, with the request that he introduce them to the British *sanguinea*. I am willing to wager that even if they came from Germany they would be hospitably licked and fed by the ants of Albion. Wasmann might, however, contend that *Lomechusa* was once a universal *sanguinea* parasite or, at any rate, much more abundant and more uniformly distributed than at present, but if this had been the case how could *sanguinea* have survived, if the ravages of the parasite are as great as he asserts, especially when we consider that *sanguinea* is itself a parasite on another ant, *Formica fusca,* and is therefore dependent on a host?

The perusal of Wasmann's papers leaves me with the impression that he is bent on showing that symphily is something biologically unique and that for every peculiarity in ant behavior we are bound to postulate a specific instinct. If three of my maiden aunts are fond of pets and prefer cats, parrots and monkeys, respectively, I am not greatly enlightened when the family physician takes me aside and informs me sententiously that my aunt Eliza undoubtedly has an ælurophilous, my aunt Mary a psittacophilous and my aunt Jane a pithecophilous instinct, and that the possession of these instincts satisfactorily explains their behavior. It is only too apparent that the physician has merely called the stimuli that severally affect my aunts by Greek names *plus* a suffix indicating "fondness," assumed their existence as entities in my aunts' minds and naïvely drawn them forth as "explanations." It is high time that such scholastic methods of conducting biological inquiries were abandoned. *Entia non sunt multiplicanda præter necessitatem* in the study of animal behavior as in other fields of research.

The observations recorded in the opening pages of this paper seem to me to constitute the most formidable argument against the existence of special symphilic instincts, for in the first place, if in the social insects the relations between parent and offspring or between the nursing workers and the offspring of the fertile females is trophallactic, it is clearly essentially the same as the relation between host and symphile. It becomes unnecessary, therefore, to assume that in the ants and termites the primitive nursing instinct, which is a mutual feeding, has been specialized or modified during the phylogeny in adaptation to particular symphiles. Slight ontogenetic modifications, well within the limits of the plastic, or "intelligent" behavior of the ants, as responses to the specific organization of the symphiles, seem amply sufficient to account for the phenomena.

In the second place, trophallaxis is, of course, traceable to a mutualistic hunger, or "exudate hunger" as Holmgren calls it, and therefore to an appetite, in the sense in which this term is employed by English psychologists. In view of the fact that psychologists have universally regarded the appetites as very primitive and fundamental it is rather strange that they have received so little attention from the animal behaviorist. Very recently, however, Drever (1917) and Craig (1918) have emphasized their importance in connection with instinct in two valuable contributions. Drever regards the appetites as very simple or primitive instincts or "as representing an earlier stage of conscious life, which in the human being and the higher animals, is overlaid by the stage to which the development of the specific 'instinct' tendencies belong." He enumerates the hunger, thirst and sex appetites, the appetite for sleep or rest, for exercise or activity, "nausea," or "primitive disgust" and James' "instinct of personal isolation." Craig's contribution is particularly interesting because he reaches his conclusions from a study of birds (doves) and deals with the matter more thoroughly. According to him the appetites and aversions are constituents of the instincts. "Each instinct involves an element of appetite, or aversion, or both." Perhaps his view is not essentially different from Drever's, since the most typical appetites, those of hunger and sex, represent the basic reactions of organisms, and what are ordinarily called "instincts," *i. e.,* the chain-reflexes, or more elaborate mechanized behavior of animals, are evidently later and superposed activities that, so to speak, adopt the general movement or pattern of expression characteristic of the appetites. Craig, in fact, resolves the behavior of animals into cycles which run their course according to the appetite or aversion schema. He evidently regards sexual behavior as the most typical expression of appetite. I should regard hunger as being certainly from a biological point of view the more primitive.[11]

If we regard symphily and trophallaxis as expressions of essentially the same instinct with pronounced appetitive constituent or pattern, we can readily understand how Wasmann was led astray by the behavior of *sanguinea* towards *Lomechusa,* for the appetites are notoriously prone to perversion. In fact, Escherich's comparison of the appetite of *sanguinea* for the secretions of the beetle with alcoholism is not altogether inept. I should prefer to compare the ant's behavior with that of a cat presented with a sprig of catnip or of a leopard presented with a ball of paper sprinkled with oil of bergamot. If the secretions of the larval and adult *Lomechusa* have an analogous influence on their hosts, as is very probable, the apparently anomalous behavior of the latter would be readily understood. It would certainly be no more surprising than that my hypothetical maiden aunts prefer to have their bed-linen scented with lavender or that some of my bachelor friends prefer Havana cigars and cannot be persuaded to smoke the "domestic" variety.

If the objection be raised that I overlook the fact that the relation of *sanguinea* to *Lomechusa* is one of host to parasite, whereas that between the queen ant and her brood is one of parent to offspring, I would reply that from a general biological point of view the resemblances between the two cases are still fundamental and suggestive. This has been shown by Giard in one of his interesting papers (1905, 1911). He says:

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[11] I find myself therefore in closer agreement with Jung than with Freud. The former's term "libido" seems to be practically synonymous with "appetite" in its general sense, as *e. g.,* in the following very suggestive passage (1916, p. 149): "We see the libido in the stage of childhood almost wholly occupied in the instinct of nutrition, which takes care of the upbuilding of the body. With the development of the body there are successively opened new spheres of application for the libido. The last sphere of application, and surpassing all the others in its functional significance, is sexuality, which seems at first almost bound up with the function of nutrition. (Compare with this the influence of procreation on the conditions of nutrition in lower animals and plants.) In the territory of sexuality, the libido wins that formation, the enormous importance of which has justified us in the use of the term libido in general. Here the libido appears very properly as an impulse to procreation and almost in the form of an undifferentiated sexual primal libido, as an energy of growth, which clearly forces the individual towards division, budding, etc. (The clearest distinction between the two forms of libido is to be found among those animals in whom the stage of nutrition is separated from the sexual stage by a chrysalis stage.)"

> Comparative ethology permits us to go further and shows us in the clearest manner that the relations between the parent organism and its progeny are in principle absolutely the same as those which exist between a parasitized animal and its parasite and that after a period of unstable equilibrium, in which one or the other of the two organisms in contact finds itself injured to the profit of its associate, there is a tendency to establish a definitive status of mutual equilibrium in which the two partners find in their association an advantage in the struggle against the *ensemble* of common causes of destruction, both cosmic and bionomic.

A partial attainment of the equilibrium mentioned by Giard, both in the nursing relation of ants and that of *sanguinea* to *Lomechusa* is brought about by mutual feeding. In neither case is the exchange of food between the two parties quantitatively equal, but the exudates as stimuli, in all probability make up in quality or intensity for what they lack in quantity.

This brings us back to Wasmann's amical selection which still remains to be considered. It has often been remarked that the symphiles are strangely like our domestic animals in that they live in a social environment where they are protected from enemies and abundantly fed. In the case of the domestic animals Darwin long ago showed that such an environment favors the production of extraordinary variations, and Pearson (1897) and Trotter (1916) agree that when organisms unite to form larger biological units such as the Metazoan body, herds, colonies and societies, the individuals though necessarily limited in their evolution along particular lines nevertheless in other respects escape from the stabilizing influence of natural selection and exhibit unusual freedom of development and specialization. Both the domestic animals and the symphiles which really become integral members of the insect societies in which they are permitted to live, show this freedom in the development of unusual structural and color characters, as we see in albinos, peculiar breeds of fowl, pigeons and dogs, Paussids and Clavigerids with monstrous antennæ, ant-chalcids like *Kapala* and *Isomeralia,* with huge thoracic spines, etc. Similar phenomena are common in many ecto- and entoparasites which are intimately associated with their hosts (*e. g., Sacculina,* many Copepods, Isopods, tapeworms, etc.). The origin of these strange characters is evidently spontaneous, or mutational and dependent on the favorable conditions under which they arise. In the case of the domestic animals we know that the unusual characters are being continuously and rapidly perfected and established by man's selective activity. It does not follow, however, that the analogous developments of symphiles are the outcome of a similar activity on the part of the ants and termites. The resemblance of the aberrant characters of symphiles to "hypertelic" structures in many other insects has been noticed by Dahl. That the phenomena in both cases are due to the same cause, *i. e.,* the relaxation or suppression of natural selection, is much more probable than Wasmann's contention that the ants take the same interest in breeding Paussids and Clavigerids with extraordinary antennæ that we do in breeding lop-eared rabbits and fan-tail pigeons. Nor is there any evidence that even the biologically useful characters of the symphiles, namely their trichome glands and exudate tissues, are engendered or perfected by amical selection. The truly amazing cases of convergent or parallel development of these structures in symphiles belonging to the most diverse genera is, in all probability, attributable to the adaptive activities of the symphiles themselves, just as we attribute the convergent development of hooks, suckers, hermaphroditism, blindness, etc., in entoparasitic worms or aptery in ectoparasitic insects, such as lice, fleas, Polyctenids, Nycteribids, etc., to the parasites themselves and not to specifically selective efforts on the part of the host organisms.

Holmgren accepts Wasmann's amical selection and carries it a step further in his contention that it accounts for the development of the various castes in the termite colony. He says (1909, p. 200):

> If now the above described connection between feeding and exudate secretion holds good, so that the quantity of exudate secretion determines the kind of feeding, it would seem to be self-evident that the exudate secretion is intimately connected with the development of castes, for Grassi and Sandias have shown that feeding is probably to be regarded as a factor in caste development. And if, therefore, the exudate secretion is the cause of feeding we must regard it as the cause of the differentiation of the various castes.

That this opinion is no longer tenable, at least in the form in which it is stated, is shown by the observations of Bugnion (1912), who has proved that the soldier and worker castes of *Eutermes* are determined in the egg, and the observations of Miss Thompson (1917), who has been able to distinguish the sexual from the sterile castes of *Leucotermes flavipes* at the time of hatching. Holmgren's thesis could be accepted only on the assumption that the effects of feeding had been carried back during the long phylogeny of the termites into the embryonic stages. Incidentally it may be said that his other statement in regard to the development of the complemental or neotenic males and females in the termite colony refer, not to the development of castes, but to the ontogenetic growth of the exudate tissues, a process which is exhibited in the most extraordinary manner during the imaginal life of the true queens of many species.

In conclusion it may be interesting to note in connection with the development of the social habit of insects from a trophallactic relation between parent and progeny, that the social or gregarious instinct in man has also been regarded by some authors as an appetite. Drever (1917) cites the early British philosopher Hutcheson ("Nature and Conduct of the Passions," Sect. 4, 1728) as classifying the gregarious instinct among the appetites, and referring to McDougal's interesting comments on gregariousness (1910), he says (p. 184):

> There is in the instinct itself something which suggests such a view [as McDougal's], something which might even lead the psychologist to maintain that it belongs to the "Appetite" group in our system of classification, an opinion to which Galton's description [of the wild ox of Damaraland which cannot endure even a momentary severance from the herd] would lend some support. There is indeed something primordial about the whole experience involved in the operation of the gregarious instinct.

The fact that higher gregarious and social animals are satisfied as long as they are with their fellows but become uneasy when isolated is certainly very suggestive of the appetitive type of behavior.[12] In this connection some of Le Dantec's recent writings are of considerable interest. In a footnote (p. 288) at the end of "Les Influences Ancestrales" (1917) he asks:

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[12] As Trotter says (1916). "In interpreting into mental terms the consequences of gregariousness, we may conveniently begin with the simplest. The conscious individual will feel an unanalyzable primary sense of comfort in the actual presence of his fellows, and a similar sense of discomfort in their absence. It will be obvious truth to him that it is not good for the man to be alone. Loneliness will be a real terror, insurmountable by reason."

> Does maternal love, which has assumed such great moral significance in the human species, originate among the females of the Mammalia as the desire (souci) to rid themselves of their milk?

A similar tendency to show that the social relation in man has an egoistic instead of an altruistic foundation is even more forcibly displayed in his startling not to say shocking, volume entitled "L'Égoisme Seule Base de Toute Société" (1916).[13]

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[13] Since the foregoing paragraphs were written I have found two quotations from Charles Bonnet's "Contemplation de la Nature," which are the more remarkable because they were published in 1764. On p. 213 he says: "In order the better to insure the well-being of their progeny, would not Nature have engaged the affection of the mothers in such a manner that the young would become for them a source of agreeable sensations and material usefulness? Certain facts seem to confirm this conjecture. . . . The mammæ have been constructed with such art that the sucking and pressure exerted by the young excite the nerves which impart to these organs a delicate disturbance or soft commotion accompanied by a feeling of pleasure. This pleasure sustains the natural affection of the mother, if indeed it be not one of its principal causes. The same may be said of the action of licking, which is reciprocal. Finally, mothers are sometimes incommoded by the abundance of their milk; the young relieve them by sucking." The second quotation (p. 272) is even more astonishing in its bearing on the conditions in the social insects: "The neuters [of bees] have no sex and do not reproduce. How can we suppose that they have the same affection for the offspring of their queen as the mothers of other animals? They behave nevertheless in the same manner under the same circumstances. If, therefore, Nature has known how to insure the attachment of mothers by the agreeable sensations derived from their offspring or by the services they render, it would certainly seem that she must employ much the same means in the case of the worker bees and that she has placed in the young a secret source of delectable sensations which attaches them to the workers and induces them to disgorge into the cells the kind of porridge with which the young are nourished." These quotations are from a work entitled "La Psychologie Animale de Charles Bonnet" published in 1909 in Geneva by Ed. Claparède who cites them and the work of Giard in support of his views on the reciprocal relations of the mother to her offspring.

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NEW NORTH AMERICAN PHORIDÆ OF THE GENUS APHIOCHÆTA[1]

(Diptera)

By CHARLES T. BRUES

The species described in the present paper are in part from the Northwest, collected by Professor A. L. Melander, and from several localities in the Eastern States. I have also been able to recognize with reasonable certainty several European species not hitherto known to occur in North America and notes on these have been included.

Five of the species described as new have the anterior tarsi strongly thickened and are on this account easily distinguished from the bulk of the North American members of the genus. Only two others of this group have hitherto been known from this continent and one from the West Indies, although a considerable series have been found in Europe.

Aphiochæta dilatata, new species.

Male. Length 1.5 mm. Black, legs dark brown, somewhat lighter on the tibiæ and tarsi; palpi pale brown; halteres black; pleuræ varied with dark brown; wings faintly brownish, almost hyaline, heavy veins fuscous. Front one-fourth wider than high, not shining and rather strongly hairy between the large bristles, especially at the middle below; four proclinate bristles of about equal size, the upper ones but little above the lower ones and twice as far apart, occupying nearly one-third the width of the front; lower reclinate bristles set with the inner one far from the eye and much below the outer one which is next to the eye; upper reclinate row distinctly curved down medially, its four bristles equidistant with the lateral ones very close to the eye; ocellar tubercle well developed; median frontal groove not very well marked. Antennæ noticeably enlarged, the diameter of the third joint equal to the greatest width of the eye; arista one-third longer than the height of the front. Palpi rather small, with four or five strong bristles at tip. Mesonotum subshining, rather densely hairy; scutellum semicircular, with two strong bristles. Propleura with several strong bristles next the coxa and several minute ones below the spiracle; mesopleura with an area of small bristles above and one long backwardly directed one at the lower hind angle of the area of small ones. Abdomen with some conspicuous bristly hairs near the apex, continued on the lower half of the sides and anterior ventral angles of the hypopygium; apex of hypopygium below with an asymmetrical hook-shaped clasper originating on the left side, extending to the right side and there curved forward. Anal organ short and stout, densely hairy, its apical pair of bristles small. Legs slender; hind femora simple; front tarsi thickened throughout, the metatarsus as stout as the tibia; setulæ of posterior tibiæ minute, not developed at all on the basal half; tibial spurs unusually weak. Costa slightly less than half the length of the wing, its cilia short, especially on the basal half; first section about one-fourth longer than the second and third combined; second very little longer than the third; costa apically and third vein unusually thick, the cell at the furcation of the third very small; fourth vein slightly curved throughout; fifth nearly straight, strongly divergent from the fourth apically; seventh long, distinct; all light veins very weak at apex, the fourth and fifth also at the base; wings broader than usual, especially on the apical half.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 148.

Female: Differs only in its smaller antennæ, and in having the first section of the costa a trifle longer and the wing somewhat narrower.

Type male and paratype female from Moscow Mountain, Idaho, June 17 (Melander).

Similar to the European *A. tarsalis* Wood, which, however, does not have the antennæ enlarged in the male.

Aphiochæta scopalis, new species.

Male. Length 2.0 mm. Deep black, legs beyond the coxæ piceous, the front pair more brown. Wings hyaline, heavy veins very dark. Front slightly broader than long, appearing broader as the margin on the sides is more deeply excavated on account of the large antennæ. Lower pair of proclinate bristles greatly reduced in size, upper ones moderately large, separated by nearly one-third the width of the front; lower reclinate bristles set close together near the eye, at almost the same level; upper row nearly straight; ocellar tubercle and median frontal groove well developed. Antennæ considerably enlarged, half as long as the eye, with a slightly pubescent arista one-half longer than the height of the front; cheeks each with a row of six strong bristles extending from the lower angle toward the antenna, the upper ones smaller, but still large. Mesonotum with a pair of sharply differentiated dorsocentral macrochætæ; scutellum broad and short, with four very long slender bristles, placed as a pair close together at each posterior angle. Propleura with several strong bristles near the anterior coxa and several very small ones just below the spiracle; mesopleura with a patch of small bristles of equal size above. Abdomen with a few scattered hairs and some more conspicuous ones on the sides below. Hypopygium of moderate size, shining toward the base; anteriorly below with a dense transverse tuft of very strong, straight, stiff bristles; behind this on the ventral surface with two longitudinal rows of delicate hooked hairs extending to the apex; above and on the sides, except at base, minutely rugulose and finely hairy; anal organ short and stout, with a few very fine hairs. Legs slender; front tarsi strongly enlarged, the metatarsus slightly broader than the widest part of the front tibia; hind femora with a series of delicate, but quite noticeable curved hairs along the lower edge; setulæ of hind tibiæ fine and closely placed, more distinct near the middle. Costa about two-fifths the wing length, its cilia moderately long and rather closely placed on apical half, shorter basally; first section about one-third longer than the second and third combined; second nearly twice as long as third; light veins but little curved, the fourth not recurved at apex, the seventh long; light veins all distinct, but not strong.

Type from Lacouner, Washington, May 23, 1908 (Melander).

This species is remarkable for its stiffly bristled and otherwise elaborate hypopygium, and could not be confounded with any other. In Wood's table of British species it will run in the neighborhood of *A. involuta* Wood, from which it differs at once in its large antennæ and in the hypopygium.

Aphiochæta palpata, new species.

Male. Length 1.5 mm. Black, legs brown. Middle and hind legs, except trochanters, very dark, almost piceous; basal half of front femora nearly as dark; apical half and their tarsi pale yellowish; other tarsi light brown; palpi black above; dark brown below; halteres black; wings hyaline, heavy veins piceous. Front as broad as long; subshining, with the fine hairs unusually stout, especially in the middle below where some are nearly half as long as the macrochætæ; upper proclinate bristles separated by one-third the width of the front, lower ones of the same size, much closer together; inner bristle of lower row nearer to the eye than to the proclinate bristle and well below the outer bristle which is next the eye; upper row slightly curved down medially, its bristles equidistant; set above the upper third of the front; ocellar bristles larger than the other; ocellar tubercle and median frontal groove well developed. Antennæ of moderate size, with long pubescent arista. Palpi small and slender, their bristles numerous but not very large; cheeks each with a pair of large bristles and a row of strong ones leading along the eye margin toward the antenna. Mesonotum rather shining, densely hairy; two scutellar bristles. Propleura with several bristles near the base of the coxa and with numerous small ones behind the spiracle; mesopleura with a patch of small, nearly equal bristles above. Abdomen dull black, with a few minute bristle-like hairs along the sides. Hypopygium small, with a row of three or four bristly hairs on each side above and a larger one at each lower anterior angle; lower posterior angle with only an extremely minute hair; lamella small, slender, with a pair of upcurved bristles at tip. Anterior tarsi strongly thickened, the metatarsus as thick or barely thicker than the broad apical part of the tibia, the latter densely hairy on is outer edge, but without distinct bristles or setulæ; setulæ of hind tibia very small, delicate and closely placed, their femora simple below. Costal vein ending distinctly before the middle of the wing; its bristles short and closely placed; its first section one and one-half times as long as the second and third combined; third two-thirds as long as the second; fork obtuse, curvature of fourth vein slight; its apex nearly straight and not recurved; fifth and sixth each slightly bisinuate; seventh very weak, almost straight.

Type from Riverton, New Jersey, June 18 (Johnson); one paratype from Chicago, Illinois, June 6, 1903 (Melander), and another from Falls Church, Virginia, July 4 (Banks).

This species is most nearly related to two European species described by Wood. From the first of these, *A. humilis,* it differs in venation and in lacking the stubby hairs on the hind femora as well as in the reduction of the lower post-antennal bristles. From *A. crassipes* it differs greatly in venation, and in the development of the lower post-antennal bristles, besides being much larger.

Aphiochæta pulla, new species.

Male. Length 2.0 mm. Black, with a brown tinge to the mesonotum; pleuræ brown, lighter below and anteriorly; palpi brownish yellow; legs dull, light yellow, darker on the tarsi; halteres pale yellow, darkened at tips, anal process honey-yellow; wings distinctly tinged with brown; venation fuscous, the light veins very distinct. Front slightly shining, as long as broad, its bristles large; lower proclinate bristles three-fourths as long as the upper and more closely placed; upper occupying nearly one-third the width of the front; bristles of lower reclinate row close together; the outer one next the eye and set but little above the inner one; upper row but little curved down medially, the inner bristles farther from one another than from the lateral ones; ocellar tubercle and median frontal groove well developed. Antennæ moderate, arista one-half longer than the front, not strongly pubescent; palpi with five or six strong bristles; cheeks each with two large bristles, the series extending from these toward the antenna weak. Mesonotum distinctly shining; scutellum with two bristles. Propleuræ with several strong bristles next to the fore coxa and a couple of weaker ones below the spiracle; mesopleura above with a patch of small bristles of approximately equal size. Abdomen rather conspicuously bristly on the apical portion of each segment, the bristles on the basal segments very small, but becoming larger on the last three segments, especially the sixth which bears on the side eight or ten long slender bristles as well as a number below. Hypopygium small with a nearly vertical series of fine closely-set bristles on the side and a tuft of fine hairs below at tip; anal process covered with long fine hairs as long as the apical pair, which is smaller than usual. Legs slender, except the anterior tarsi which are strongly flattened, especially the metatarsus, which is fully as wide as the broadest part of the anterior tibia. Posterior femora slender, simple, not fringed beneath, their tibiæ without distinctly dfferentiated setulæ. Costal vein reaching to the middle of the wing, with very long, moderately strong bristles, each about as long as the last section of the third vein; first section of costa distinctly, but not much longer than the second and third combined; third section two-thirds the length of the first; fourth vein weakly curved at base, nearly straight beyond, not recurved at tip; fifth, sixth and seventh nearly straight, the seventh long and strongly developed.

Type from Moscow Mountain, Idaho, September 9, 1908 (Melander).

This would run in Wood's table (Ent. Month. Mag., vol. 20. p. 114 (1909)) to *hortensis* Wood, except that the halteres are not black. It differs from that species by the bristly apex of the abdomen and the neuration. Otherwise the two are very similar and undoubtedly closely related.

Aphiochæta capillaris, new species.

Female. Length 2 mm. Black, slightly brownish on the pleuræ; legs piceous, distinctly yellowish basally on the two posterior pairs and the front pair entirely pale yellowish; palpi yellow; posterior margins of abdominal segments pale; halteres black; wings hyaline, with pale venation. Front as broad as high; four proclinate bristles, the lower pair noticeably weaker than the upper and placed close together far below them; upper pair separated by one-third the width of the front; inner bristle of lower reclinate row placed far below the outer one and much further from the eye; upper row straight, placed higher on the front than usual; ocellar tubercle very prominent; median frontal groove present, but not very pronounced; antennæ small, brown; arista thinly pubescent, one-half longer than the front; palpi moderate, with strong, rather short bristles, cheeks each with two long macrochætæ. Mesonotum shining, with a pair of distinct, widely separated dorsocentral macrochætæ; scutellum broad, with two strong bristles behind and two much weaker ones laterally. Propleura with one strong and several weak bristles near the coxa and two weak ones below the spiracle; mesopleura with a patch of very small bristles above and one greatly enlarged, backwardly directed one at the posterior edge. Abdomen slightly hairy on the sides and near apex, but without prominent bristles at the sides of the second segment. Legs slender, the anterior tarsi greatly swollen, the metatarsus as thick as the thickest portion of the tibia and the following joints also strongly thickened; cilia of hind tibiæ distinct, but not large and placed rather far apart, weaker on the basal half. Costa extending just to the middle of the wing, with close-set rather short cilia, those on the basal half much shorter than those on the apical half; first division of costa distinctly longer than the second which is slightly more than twice as long as the third; fourth vein gently curved at base, nearly straight beyond and not recurved at the apex; fifth and sixth strongly divergent apically; seventh very weakly defined.

Type from Great Falls, Virginia, October 21 (Nathan Banks); paratype from Falls Church, Virginia, June 7 (Banks).

This is similar to *A. dilatata* Brues.

Together with the four preceding species it has the anterior tarsi enlarged. All the members of this group known from North America may be distinguished by the aid of the following key:

1. Scutellum with four equally strong bristles........................2
   Scutellum with only two bristles..............................5
2. First division of costa noticeably longer than the second; costal fringe of moderate length..............................3
   First division of costa about equal to the second; costal fringe very short..............................*magnipalpis* Ald.
3. Halteres pale yellow; palpi of male much enlarged and with only minute bristles..............................*projecta* Becker
   Halteres brown or black; palpi bristly as usual....................4
4. Costa two-fifths the wing length; hypopygium with very large bristles ....*scopalis* Brues
   Costa extending to the middle of the wing; hypopygium not noticeably bristly ....*californiensis* Malloch
5. Halteres black; costal cilia short................................7
   Halteres pale 6
6. Costal cilia very long....................................*pulla* Brues
   Costal cilia short..................................*johnsoni* Brues
7. Mesopleural bristles of approximately equal size......*palpata* Brues
   One mesopleural bristle enlarged, much longer and stouter than the remainder 8
8. Posterior tibiæ with well-developed setulæ, front as high as broad ....*capillaris* Brues
   Posterior tibiæ without distinct setulæ; front one-fourth broader than high..............................*dilatata* Brues

Aphiochæta centralis, new species.

Female. Length 2.3 mm. Black, the pleuræ and legs very dark brown; front legs distinctly lighter; antennæ brown-black; palpi dark yellow, much infuscated above; wings with a brownish cast, more pronounced apically; halteres black. Front about one-third broader than high, with large bristles; four proclinate bristles, the lower pair half the size of the upper and close to them although more approximate; upper pair occupying one fourth the width of the front, inner bristle of lower reclinate row somewhat below the outer one and set near the post antennals so that it is equidistant from the eye margin and the median line; inner bristle of upper row equidistant, the median pair slightly lower than the outer one; ocellar tubercle and median frontal groove well developed. Antennæ rather large, with a nearly bare arista slightly longer than the front; palpi of good size, with strong bristles; proboscis extruded, but not thickly chitinized. Front strongly pollinose, with many small bristly hairs. Cheeks with several strong bristles below; post-ocular cilia unusually strong. Mesonotum shining, very bristly on the sides and behind, just before the scutellum. Scutellum with four very large, equal, marginal bristles. Peropleura with four strong bristles next the coxa and three weaker ones below the spiracle, bare between, mesopleura bare. Abdomen hairy near tip, but without distinct bristles on the sides of the second segment. Legs rather slender, the fore tarsi not at all thickened; hind tibiæ with weak, widely placed cilia on the apical half which become obsolete toward the base. Wings large, rather long and narrow. Costa extending distinctly beyond the middle of the wing, with short, closely placed cilia. First section of costa as long as the second and third combined; second nearly three times as long as the third; fourth vein sharply curved at base, straight beyond; fifth and sixth slightly sinuate; seventh rather long.

Type from Battle Creek, Michigan.

This species is related to *A. johannseni* Malloch, but the frontal chætotaxy is quite different, the costal fringe is not long, and it is a smaller species.

Aphiochæta pleuralis Wood.

Entom. Monthly Mag., vol. 20, p. 117 and 146 (1909).

A series of ten specimens from Algonquin, Illinois, collected in October, 1895, by Dr. Nason, have been in my collection for a number of years. They represent both sexes and seem to be identical with this European form so far as I can judge from Wood's very complete description. In Malloch's key to North American species it will fall near *ciliata* on account of the enlarged bristle (or two) on the mesopleura. *A. nasoni* recently described by Malloch (Bull. Brooklyn Ent. Soc., vol. 9, p. 58 (1914)) will also run to *ciliata* in the same key, but is very different from *pleuralis* although strangely enough it also was obtained by Dr. Nason at Algonquin, where the specimens of *pleuralis* were collected. I have additional specimens from Lyndon, Washington, July 29, 1908 (A. L. Melander), from Milton, Massachusetts, and from New Bedford, Massachusetts.

Aphiochæta subpleuralis Wood.

Entom. Monthly Mag., vol. 20, p. 118 and 146 (1909).

I have a single male which I think is this species, as it departs in no way from Wood's comprehensive description. Wood says that this is a common and widely distributed species in Great Britain and that it is probably the *pulicaria* of Meigen and Becker, but not of Fallen. It seems probable, therefore, that this is an abundant palæarctic species that extends into western North America, particularly as Becker records his *pulicaria* from Siberia as well as Europe.

Aphiochæta beckeri Wood.

Entom. Monthly Mag., vol. 20, p. 115 and 144 (1909).

A single male from Moscow Mountain, Idaho, sent me by Professor Melander, seems to be this species, hitherto known from Great Britain. The American specimen has the palpi almost black as well as the anal organ, and the tibial cilia, although well developed, could hardly be considered as sparse. I can make out no other differences, however, from Wood's description. The species is rather conspicuous on account of its very broad front, strong bristles on the head and propleuræ, the bristling of the hypopygium and the color and venation of the wings.

Aphiochæta divergens Malloch.

Proc. U. S. Nat. Mus., vol. 43, p. 480 (1912).

I have two good series, comprising both sexes of this species. One lot collected by Dr. Nason at Algonquin, Illinois, years ago agrees perfectly with the original description but a series from Pullman, Washington, collected by Professor Melander, have the palpi somewhat infuscated instead of clear yellow, although otherwise indistinguishable. The Illinois specimens were taken in September and the Washington ones in May and September, some of them on windows. The anterior tarsi, especially the metatarsus, are strongly thickened in the male, but not noticeably so in the female.

Aphiochæta glabrifrons Wood.

Entom. Monthly Mag., vol. 20, p. 27 and 62 (1909).

A single female undoubtedly belonging to this palæarctic species was taken at Framingham, Massachusetts, by Mr. C. A. Frost. The proboscis is swollen and very pale yellow like the anterior coxæ.

Aphiochæta modesta, new species.

Male. Length 2 mm. Black; legs very dark brown, with the front pair much lighter and their coxæ light brownish yellow; palpi clear yellow; halteres black; anal organ deep yellow with dusky base; wings distinctly tinged with brown, heavy veins pale, but light veins rather dark. Front short, one-third broader than high; slightly shining. Two pairs of proclinate bristles, the lower pair much smaller and rather close together; upper pair very widely separated, occupying slightly more than one-third of the width of the front; bristles of lower row very close together next the eye, but the inner one distinctly lower than the outer one which is in line with the upper proclinate bristles; upper row of four nearly equidistant bristles, the middle pair a little lower than the lateral ones; ocellar tubercle and median frontal groove well developed. Antennæ somewhat under-sized, the arista long, slightly more than twice as long as the height of the front. Labrum not prominent, palpi rather stout, with strong bristles. Cheeks each with two very strong bristles and a series of much smaller ones running up the orbits to the antennæ. Mesonotum rather elongate, shining; scutellum subtriangular, with only two bristles; dorsocentral bristles well differentiated, without any smaller bristles between them. Pleuræ shining, propleura with several bristles next the front coxa and a couple of minute ones just below the spiracle; mesopleura bare. Abdomen bare at base, but rather bristly near apex, especially on the sixth segment. Hypopygium of moderate size, not shining, with some bristles at the base, especially below, and also with several minute bristles near the base of the anal organ which is rather small and furnished with unusually stout hairs. Legs rather stout, but the tarsi all slender; hind femora without noticeable hairs below; cilia of hind tibiæ short, delicate and widely placed, very weak near the base and apex. Wings very long and narrow, with the costa extending well beyond the middle; its cilia short and very closely placed, extremely short near the base of the costa; first section slightly, but distinctly, longer than the other two combined; second half as long as the first and nearly three times as long as the third; fork of third vein rather acute and the cell long; fourth vein sharply bent at base, straight beyond and faintly recurved at tip; fifth slightly sinuate; sixth strongly so; seventh very long.

Type from Lyndon, Washington, July 29, 1908 (Melander).

This species is not closely related to any described North American species; among the European species it would fall near *longiseta* Wood, from which it differs at once by its broader front, infuscated wings, and longer first section to the costa.

THE DIPTEROUS GENUS DRAPETIS MEIGEN
(Family Empididæ)

BY

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Pullman, Washington.

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THE DIPTEROUS GENUS DRAPETIS MEIGEN (Family Empididæ).*

By A. L. Melander,
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The species of Drapetis are to be distinguished from the remainder of the Empididæ by the following summarized combination of characters. Thorax robust, the humeri not swollen and constricted. Eyes closely approximate on the face, but on the front diverging above; palpi broad, incumbent on the very short proboscis; antennæ three-jointed, with terminal or subterminal arista; one pair each of vertical and ocellar bristles. Legs hairy and often furnished with bristles or setæ, the middle femora however rarely armed and not thicker than the front pair. First basal cell of the wings shorter than the second which is united with the discal cell, anal cell completely wanting, only two posterior cells before the anal area.

The genus Drapetis includes very small flies, among the smallest of all the Diptera, which are found during the spring and summer, sometimes swarming about flowers like wild cherry and plum, and sometimes running about singly over grass and low shrubbery. Their early stages are quite unknown. In the tropics slender yellow-colored species predominate but in the Temperate Zone the general species are black and more robust.

In the following pages are given a detailed discussion of the external morphology of the drapetine flies, a synoptic table to the fifty-five North American forms, descriptions of forty-two new species and varieties, and a complete bibliography to the genus and to the 133 described species and varieties at present known from the whole world, including four fossil species. The writer's personal collection contains sixty-seven of the named species and varieties, of which forty-six species are represented by type material. In addition he has studied Coquillett's types at the National Museum and Loew's types at the Museum of Comparative Zoology.

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* Contribution from the entomological laboratories of the Bussey Institution for Applied Biology, Harvard University. No. 149.

During the year 1899, while a student at the University of Texas the writer began a study of the Empididæ, a family of predatory dipterous flies. Since that time several papers dealing with the taxonomy of the family have appeared from his pen, notably a review of the North American species known up to 1902, which was published as a thesis for the master's degree. The accumulation of a wealth of material in this family, especially from the rich collecting fields of the Pacific North-west, led to the preparation of an exhaustive review of the group which was accepted by Harvard University in 1914 as the thesis requirement for the degree of Doctor of Science. It was the writer's intention to issue this manuscript of quite one thousand pages in the Genera Insectorum, but the outbreak and centralization of the war in Belgium entirely precluded this possibility. Since many of the new species have been distributed among museums and individual collections it seems desirable to have their names published. The following pages, dealing with the single genus Drapetis, have been excerpted as the first presentation of the dismembered dissertation.

Etymologically the name *Drapetis* comes from the Greek word *Drapetis*, meaning a runaway. Since the penult is formed with the short vowel epsilon the accent in English pronunciation falls on the first syllable, *i. e.*, Drap-e-tis.

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GENERAL MORPHOLOGY.

Head globular, sometimes slightly longer than high, the occiput more or less hemispherical; eyes large, bare, at most with scattered microscopic hairs, the facets of uniform size, beneath the antennæ the eyes of both sexes nearly touching, leaving the face linear or very narrow, above the eyes the front is V-shaped, always broader than the face, sometimes the front is quite narrow; three small ocelli present. Excision of the eyes at the level of the antennæ very large; cheeks sometimes entirely obliterated, usually about one-eighth the height of the eye, with the oral margin obliquely descending posteriorly. Proboscis thick, rather sharply pointed, perpendicular or directed backward, averaging one-half the height of the head, its labrum with prominent base and as long as the labium; palpi broadly oval, one-jointed, applied to the proboscis, the inside glabrous and shining, the outside pollinose and with more or less evident recumbent pubescence, generally tipped with a longer seta. Antennæ inserted close together a little above the middle of the head, three-jointed, very rarely the basal joint is wanting, the second joint with a circle of small setulæ, the bottom hair of which is sometimes long, the third joint compressed, varying from short oval, not longer than deep and with subterminal arista to lanceolate or conical, nearly twice as long as deep and with terminal arista; the arista usually slender, nearly bare, two-jointed, its basal joint small, its outer joint two or three times as long as the antennæ, rarely the hairy coating is dense and longer so as to give a thickened appearance to the arista. Occiput often with a pollinose band on the lower orbits including the cheeks excepting their lower margin, usually with sparse short hairs, typically a pair of ocellar and one of vertical bristles present, rarely two or three pairs of vertical and an additional pair of post-vertical bristles present, sometimes an oral bristle on the back part of the cheeks.

Thorax robust, polished, nearly bare to pubescent, dorsocentral bristles usually limited to a pair of prescutellars, humeral and posthumeral bristles present or absent, notopleural bristles present but variable, scutellum with two or four marginal bristles, the lateral ones always shorter; pleuræ bare, rarely with pollinose streaks following the sutures. Abdomen with eight segments, the first segment laterally inflated, the fourth segment usually large and more heavily chitinized than the others, its sides often pollinose and bearing scimiter-shaped, glistening setulæ, the fifth segment short; pygidium varying from small to large, closed to widely open, asymmetrical, the right side usually with a broad, curved, furcate valve. Legs rather stout, the front femora a little the strongest, usually the anterior femora with a basal flexor hair and with a preapical bristle on the outer side, the hind femora with one to three preapical bristles on the anterior face, hind tibiæ with extensor bristles and more or less produced as an apical tooth-like spur, the anterior tibiæ with a pair of apical bristles; sometimes the legs are devoid of all bristles; pulvilli broad; in those species with broad tibial spur the inside of the hind metatarsi and of the end of the hind tibiæ spongy pubescent.

Wings with anal angle more or less developed, except very rarely the first basal cell shorter than the second which is always fused with the discal cell, five simple longitudinal veins, anal cell completely wanting, at most a short trace of the anal vein present toward the hind margin but the anal cross-vein always lacking, usually the entire margin of the wing uniformly short-ciliate, sometimes the hairs of the first section of the costa are longer, no stigma and no definite color pattern.

The species of *Drapetis* are included in the following subgenera:

1. *Drapetis* Meigen, sens. str. Type species, *exilis* Meigen. Rather small, bristleless, black species, with short antennæ directed somewhat upward, the second joint without a conspicuous seta beneath, the third joint oval, with long, subterminal arista; legs without strong bristles,

the hind tibiæ without the terminal spur; notum densely short-pubescent, the hairs appressed, no humeral or discal bristles; wings broad, costa short-pubescent, third vein sometimes curved forward; halteres usually black.

2. *Eudrapetis*, subgen. nov. Type species, *spectabilis* Melander. Robust, larger species, more or less bristly and black; antennæ longer, directed obliquely upward, the second joint with a pronounced seta beneath, the third joint ovate to lanceolate, with a long terminal arista; femora with preapical bristles, anterior tibiæ with apical bristles and the hind ones with a more or less evident terminal spur and usually with extensor or apical bristles; humeral, and sometimes discal bristles (*e. g.*, posthumeral, supraalar and anterior dorsocentrals) present; wings broad, costa short-pubescent, third vein straight or recurved; halteres yellow.

3. *Elaphropeza* Macquart. Type species, *ephippiata* Fallen. Usually yellow, sometimes black species; antennæ elongate, horizontal, the second joint without seta beneath, the third joint lanceolate, two or more times the length of the first two joints together, the terminal arista relatively short, sometimes no longer than the antennæ; abdomen broad, the middle segment with flattened setulæ; legs slender, the hind tibiæ with extensor bristles and with a more or less evident terminal spur; wings narrower, the hairs of the base of the costa longer than elsewhere.

4. *Ctenodrapetis* Bezzi. Type species, *ciliatocosta* Bezzi. Body slender, elongate, usually yellow, the abdomen longer than the thorax; antennæ elongate, horizontal, the second joint without seta, the third joint lanceolate with relatively coarsely pubescent terminal arista; legs slender, with bristles and a long terminal spur on the hind tibiæ; wings long, narrow, cuneate, the costal margin with long cilia.

SYNOPSIS OF THE NORTH AMERICAN SPECIES OF *Drapetis*, S. LAT.

1. Legs mostly black, femora entirely or mostly black......................2.
   Anterior femora more or less yellowish, in addition to the knees........23.
2. Hind tibiæ without evident bristles, tibiæ without apical spurs; halteres black; no dorsocentrals..3.
   Hind tibiæ almost always with one or more bristles on the extensor side, tibiæ with apical spurs; halteres whitish............................10.
3. Anterior cross-vein before the middle of the discal cell, last section of the fifth vein much shorter than the preceding; third antennal joint short ovate...4.
   Anterior cross-vein beyond the middle of the discal cell, sections of the fifth vein subequal..5.
4. Wings hyaline, third vein uniformly diverging from the fourth; arista terminal...*assimilis* Fallen.
   Wings infumated, third and fourth veins parallel toward their end: arista subterminal.......................................*infumata*, n. sp.
5. Third vein uniformly diverging from the straight fourth; pygidium not cleft; head higher than wide, the eyes nearly touching above the antennæ, ocelli minute; mesonotal hairs short.......................6.
   Third vein becoming subparallel with the fourth toward the end, the fourth vein with a more or less evident downward bend beyond the discal cell; head globular, the eyes distinctly separated above the antennæ, the ocelli large; mesonotum pubescent.........................7.

6. Hind femora with two strong processes above; fourth vein ending before the tip of the wing, first vein ending before the middle of the wing, third section of the costa shorter than either the second or the fourth; pygidium large..*diversa*, n. sp.

Hind femora unarmed; fourth vein ending beyond the tip of the wing, first vein ending near the middle of the wing, third section of the costa longer than either the second or the fourth; pygidium minute, triangular in outline; front coxæ yellowish....................*naica*, n. sp.

7. Pygidium small, not deeply cleft, circular in outline; last abdominal segment not fringed..8.

Pygdium large, deeply cleft, the left valve with bristly fringe; last segment of male abdomen fringed with hairs..........................9.

8. Hind metatarsi yellowish; notal hairs obliquely outstanding; hypopygium transversely depressed, slightly open on the right side; eastern species ....*pilosa*, n. sp.

Tarsi black; notal hairs decumbent; hypopygium globular and closed; western species.......................................*micropyga*, n.sp.

9. Abdomen and pygidium with fine pale hairs; veins black and thick, the third section of the costa much longer than either the second or the fourth; tarsi and front tibiæ brown.................*aliternigra*, n. name

Pygidium with many coarse black setulæ; veins slender, the third section of the costa subequal to the second and the fourth; legs entirely black ....*dividua* Melander

10. Hind tibiæ with long, flattened, scale-like hairs along the inner side and with only preapical bristles, the apical spur large and lappet-like; third antennal joint short ovate, the arista subterminal; third and fourth veins converging apically............................*plumipes*, n. sp.

Hind tibiæ not plumed with long flexor hairs.............................11.

11. Hind tibiæ with six short extensor bristles, the terminal spur strong; arista subdorsal, third antennal joint short ovate.......*dorsiseta*, n. sp.

At most three extensor bristles on the hind tibiæ; arista terminal........12.

12. Hind tibiæ prolonged on the inside as a strong lappet projecting beyond the insertion of the tarsus, hind metatarsi with strong setulæ beneath, middle tibiæ without extensor bristle; four dorsocentrals............13.

Hind tibiæ not or scarcely prolonged, certainly not lappet-like, metatarsi setulose only in *medetera*..19.

13. Front coxæ and femora entirely black; anterior cross-vein beyond middle of cell; only middle pair of scutellar bristles long.....................14.

Front coxæ somewhat yellowish; anterior cross-vein at or before middle of cell...16.

14. Arista 2.5 times as long as the antenna; hind tibiæ without extensor bristles; upper orbits polished; veins coarse and blackish, the first posterior cell narrowed apically..........................*nitens*, n. sp.

Arista 1.5 times as long as the antenna; hind tibiæ with one or two extensor bristles; occiput pollinose; veins pale, the first posterior cell not markedly narrowed at apex (*unipila* Loew)..................15.

15. Hind tibiæ with one bristle, located at the basal third...var. *unipila* Loew

Hind tibiæ with two extensor bristles, one before the middle, the other at the beginning of the apical third of the tibial length............ var. *nitida* Melander

16. Scutellum with four long equal bristles; hind tibiæ without extensor bristles; hind metatarsi black, darker than the tibia; palpi black.... *quadrisetosa*, n. sp.

Scutellum with only the middle pair of bristles long; hind metatarsi rarely contrasting...17.

17. Occipital orbits heavily white pruinose; sides of the middle segments of the abdomen white pruinose; posterior cross-vein before the middle of the wing, sections of the fourth vein proportioned 1:1:4, of the fifth vein, 1:1...18.

Orbits not differentiated; sides of the abdomen not pruinose; posterior cross-vein at the middle of the wing, the sections of the fourth vein, 1:1.2:2.3, of the fifth vein, 1:0.5, the second, third and fourth sections of the costa, 1.5:2:1...................................*inculta* Coquillett

18. Hind tibiæ without extensor bristles; second, third and fourth sections of the costa, 2.5:1.6:1, middle segments of the abdomen with flat glistening setulæ; base and apex of the front femora, front tibiæ and base of the front tarsi yellow; palpi yellow.....................*lata* Coquillett

Hind tibiæ with a strong extensor bristle near the middle, legs uniformly brownish; costal sections, 1.6:1:8:1; palpi blackish...*spectabilis* Melander

19. Middle tibiæ with a long extensor bristle at the basal third, hind tibiæ with a bristle above and one below the middle, hind femora with a preapical extensor bristle and with three preapical bristles on the front side; five dorsocentrals; pygidium large; hairs of the mesonotum black, of the legs long and blackish.................*medetera* Melander

Middle tibiæ without an extensor bristle, hind femora without extensor bristles, hind metatarsi not setulose; pygidium smaller..............20.

20. Hind tibiæ without extensor bristles; antennæ short, the third joint ovate; veins coarse and brown or black..21.

Hind tibiæ with two short extensor bristles located at the middle and near the end; antennæ elongate, the third joint lanceolate; veins not coarse and unusually pale...22.

21. Hind femora ♂ with a strong swelling beyond the middle bulging out the anterior side; vertex broadly polished; basal section of the fifth vein slightly longer than the evanescent outer section; legs brown...... *œdimera*, n. sp.

Hind femora not bearing an abnormal swelling; vertex subshining, the occiput cinereous, the front and lower orbits white pruinose; sections of the fifth vein subequal; legs mostly black..........*parvicornis*, n. sp.

22. Front femora ♂ with a bunch of six black setulæ in the middle of the upper side, represented in the ♀ by one or two; no dorsocentrals, dorsum of ♂ nearly glabrous, of ♀ with white hairs; one preapical bristle on the front edge of the hind femora.............*armata*, n. sp.

Front femora not setulose, two preapical bristles on the front edge of the hind femora; five dorsocentrals........................*scissa*, n. sp.

23. Thorax black..24.

Yellow or reddish species; second joint of the antennæ without a seta beneath...41.

24. Under side of hind femora ♂ armed with a pair of long curved black spinous bristles, legs otherwise bristleless; halteres black; third vein curving away from the fourth; pleuræ shining; palpi and base of antennæ yellow..................................*bispina*, n. sp.

Femora not so armed; species differing from preceding also in two or more other characters..25.

25. Third vein curving forward, widely diverging from the fourth; pleuræ opaque pollinose except the center of the sternopleura; halteres and fringe of calypteres yellow...........................*divergens* Loew

Third and fourth veins at least subparallel toward their tip; pleuræ shining except rarely on the sutures...................................26.

26. Legs without bristles, at most weak hairs on the base of the front femora beneath and near the apex of the hind ones; no dorsocentrals.........27.

Femora and tibiæ with bristles; halteres yellow.......................31.

27. Discal cell long, the ultimate section of the fifth vein much shorter than the preceding, posterior cross-vein opposite the end of the first vein, the anterior cross-vein at or before the middle of the discal cell; mesonotum pubescent...28.

Discal cell small, sections of the fifth vein nearly equal, the posterior cross-vein before the end of the first vein, the anterior cross-vein beyond the middle of the discal cell, the second section of the costa shorter than the third..29.

28. Hind tibiæ ciliate along the outer edge; halteres black; veins dark, the second section of the costa equal to the third......*latipennis* Melander

Tibiæ not ciliate; halteres yellow; veins brown, the second section of the costa shorter than the third.........................*discalis*, ns. p.

29. Antennæ, palpi and proboscis pale yellow; notum not densely pubescent; veins brown, the third vein straight, ♂ with the pedicel of the second and third veins broadened to a black disk and with a stout flexor bristle near the end of the hind tibia; halteres yellow.....*flavicornis*. n. sp.
Antennæ and mouthparts black; mesonotum densely pubescent; veins black, the third vein sinuous; ♂ not thus distinguished; halteres black..........30.

30. Pygidium rounded, closed and without long hairs...........*setulosa*, n. sp.
Pygidium open, asymmetrical, the right side projecting as a curled, black setulose lamella, the left side of the pygidium clothed with long, black, hair-like bristles..........*trichura*, n. sp.

31. Second antennal joint with a long seta beneath; hind femora with preapical bristles on the front side, hind tibiæ with more or less developed apical spur..........32.
[Second antennal joint without a long seta; hind femora without preapical bristles, hind tibiæ with extensor bristles..........39.

32. Hind tibiæ with a strong lappet and with a long extensor bristle at its middle but without subapical bristles; three preapical bristles on the outside of the hind femora, hind metatarsi yellow-setulose beneath; pubescence of the mesonotum long and pale, dorsocentrals present; anterior cross-vein just before the middle of the discal cell; eyes nearly touching above the antennæ................*spectabilis* Melander
Hind tibiæ without extensor bristle but with subapical ones, hind metatarsi darkened and not setulose; mesonotal pubescence short; eyes distinctly separated above the antennæ..........33.

33. Hind tibiæ with a rather strong apical spur..........34.
Apex of the hind tibiæ simple; pubescence of dorsum blackish; veins dark ....*gilvipes* Loew

34. Hairs of the thorax and of the calypteres whitish, some weak erect dorsocentrals on the disk of the mesonotum..........35.
Hairs of the thorax and calypteres blackish, no erect dorsocentrals on the disk of the thorax; anterior cross-vein beyond the middle of the discal cell..........37.

35. Anterior cross-vein at the middle of the discal cell; scutellum with four bristles; veins strong; one strong preapical extensor bristle on the hind tibiæ, femora largely blackish.................*femoralis* Melander
Anterior cross-vein at three-fifths the length of the discal cell, veins weak; scutellum with two bristles; preapical extensor bristle of the hind tibiæ weak, legs mostly luteous..........36.

36. Hairs of the thorax fine but dense; face broader above and below and opaque gray pollinose, front pollinose; legs luteous........*facialis*, n. sp.
Hairs of the thorax sparse; face black, narrower below, the front black; abdomen shining, nearly bare, pygidium very large; hind femora blackish ....*diversipes*, n. sp.

37. Apical spines of the hind tibiæ stout, hind femora usually not blackened; first posterior cell widest before its end..........*xanthopoda* Williston
Spines at the end of the hind tibiæ not unusually stout, hind femora dark on the distal half; third and fourth veins parallel..................
(*septentrionalis* Melander) 38.

38. Face linear, eyes subcontiguous beneath the antennæ; palpi black........
septentrionalis Melander
Face narrow, white pollinose, the eyes distinctly separated; palpi yellow
var. *mexicana*, n. var.

39. Hind tibiæ with a single extensor bristle near the middle; front very narrowly V-shaped; veins blackish and strong............*inermis*, n. sp.
Hind tibiæ with two extensor bristles; front narrowly V-shaped; veins slender..........40.

40. Antennæ black, the third joint lanceolate; hairs of the body black and numerous, six acrostichals; sides of the fifth segment of the abdomen with many short scale-like setulæ; tibial spur short..........*nigricans*, n. sp.
Antennæ yellow, the third joint short; hairs of the body pale and very sparse, two acrostichals; tibial spur long................*tenera*, n. sp.

41. Hind tibiæ without long extensor bristles, but instead seriately bristly, hind metatarsi with an erect comb of seven bristles; halteres blackish; four rows of acrostichals; first posterior cell widest before the end; tibial spur small.......................................*comata*, n. sp.
Hind tibiæ with two or one long extensor bristles, hind metatarsi not pectinate; halteres yellow..42.

42. Third and fourth veins converging, the first posterior cell widest before its tip; antennæ dark; scutellum and metanotum yellow, four acrostichals; tibial spur small...................................*inflexa*, n. sp.
Third and fourth veins not converging, the first posterior cell widest before its tip; antennæ yellow......................................43.

43. Mesonotum and pleuræ largely black, the notopleural suture broadly yellow; dorsal hairs long; tibial spur black; one extensor bristle on hind tibiæ; upper orbits polished.......................*seminigra*, n. sp.
Thorax mostly or wholly yellow..44.

44. Mesonotum with a median brown vitta, upper pleuræ brown; front linear; tibial spur long...*vitatta*, n. sp.
Mesonotum and pleuræ not vittate; front narrow, its sides converging below..45.

45. Hind tibiæ with a single extensor bristle; posterior half of the mesonotum with a large crescentic black mark........................*upsilon*, n. sp.
Hind tibiæ with two extensor bristles; posterior part of the mesonotum marked at most with a prescutellar spot..............................46.

46. Pleuræ with a large round subalar spot, a rounded prescutellar spot fused with the black scutellum; mesonotal hairs sparse; tibial spur strong but blunt...*pleuralis*, n. sp.
Pleuræ unspotted, mesonotum reddish, sometimes with black metanotum, scutellum and prescutellar spot.......................................47.

47. Tibial spur blunt; third antennal joint conical, twice as long as broad; abdomen yellow apically; sections of the fourth vein proportioned 1 : 3, of the fifth vein, 2.5 : 1........................*rectineura*, n. sp.
Tibial spur long and sharp; third antennal joint less than twice as long as broad; abdomen often entirely black.................................48.

48. Middle tibiæ ♀ not setulose, of ♂ at most microscopically setulose; scutellum reddish, mesonotal hairs sparse; length 1.5–2 mm.........49.
Middle tibiæ ♂ ♀ setulose with black denticles within; scutellum black; genitalia sometimes yellow; mesonotum hairy; sections of the fourth vein, 1 : 2.2; length 2–3 mm..50.

49. Sections of the fourth vein proportioned 1 : 4; abdomen black; occiput polished black, without pollen..........................*luteicollis*, n. sp.
Sections of the fourth vein proportioned 1 : 2.2; abdomen black on the middle segments only; occiput subshining, coated with fine gray pollen ....*simplicipes*, n. sp

50. Occiput polished black, without pollen; front femora ♂ ♀ without black setulæ below; third antennal joint yellow, arista slender; pygidium without pollen, shining.....................................*calva*, n. sp.
Occiput pollinose; third antennal joint darker than the basal joints........51.

51. Arista heavily pubescent, appearing half as thick as the third joint; bristles of the hind tibiæ distant; lower part of the head yellow; second section of the costa longer than the fourth and but little shorter than the third.....................................*plumea*, n. sp.
Arista not thickly pubescent, less than half as thick as the third antennal joint..52.

52. Front femora ♂ with black setæ beneath, bristles of the hind tibiæ distant ....*flavida* Williston
Front femora ♂ ♀ with black flexor setæ, the bristles of the hind tibiæ close together...(*læta*, n. sp.) 53.

53. Prescutellar dark spot present; wings three times as long as broad; occiput pollinose to the eyes.....................*læta*, n. sp. and var.
Prescutellar spot wanting; wings less than three times as long as broad....54.

54. Spur of the hind tibiæ forming a long slender curved yellow hook; occiput pollinose to the eyes..........................var. *ungulifera*, n. var.
Spur of the hind tibiæ forming a large broad black lappet; upper occipital orbits shining ....var. *nigrocalcarata*, n. var.

Drapetis aliternigra, sp. nov.

nigra Melander, Tr. Am., Ent. Soc. xxviii. 208, f. 12, 17, 24 (1902).

Length 1.6 mm. Head round; occiput subshining, bottom of the front one-third to one-half as wide as the second joint; face and cheeks linear; palpi black overlaid with brown; second joint of the antennæ without a seta; one pair of diverging postocellar bristles, two or three verticals. Mesonotum closely pubescent, no discal bristles, the lateral ones confined to three or four in front of the wings, lateral scutellar bristles small; pleuræ shining. Legs simple, without bristles, the front knees more or less brownish.

Washington, British Columbia, Texas, South Dakota, Pennsylvania, New York, Massachusetts.

The species is very close to *naica*, but in that species the third vein has a uniform anterior curve, there are no postocellar bristles, the ocellar and vertical bristles are small and the head is longer than wide, with the front at the bottom less than one-third as wide as the second joint of the antennæ. In *aliternigra* the ocellar, postocellar and vertical bristles vary in size.

Drapetis bispina, sp. nov.

♂. Length 1.4 mm. Head, thorax and abdomen black, legs including the coxæ entirely yellow. Head spherical; occiput lightly dusted, orbits not differentiated; front and face very narrow, almost linear, the lowermost sides of the dusted face somewhat diverging; antennæ one-third the head-height, the basal joints yellowish, the second joint without seta, the third joint black, triangularly ovate, as long as the basal joints together, the terminal arista one-half longer than the antennæ, short-pubescent; palpi and a pair of apical setæ yellow, proboscis brown. Mesonotal hairs blackish, rather long and dense, obliquely outstanding, only the posterior dorsocentral bristles evident, no humeral, 3 supraalar, 1 intraalar, 4 scutellar bristles, pleuræ mostly polished. Abdomen shining, the hairs rather evident especially the brown ones margining the last tergite and the pale ones of the underside of the hypopygium; hypopygium oblong, larger than the vertical diameter of the abdomen, nearly erect but somewhat twisted to the right, its left valve with broad rounded end, the penis exserted as a curled filament. Legs relatively stout, covered with yellow hairs which are long but sparse on the underside of the anterior femora, otherwise devoid of bristles except for a pair of contiguous curved black spines located on the inner flexor side of the hind femora at three-fourths the length and extending as far as the knee, inner apical side of the hind tibiæ with a small luteous lappet covering the very base of the metatarsus, no tibial spurs. Halteres black, the roots fuscous; hairs of the calypteres golden. Wings hyaline, veins narrow and light brown, all the veins diverging, costal sections proportioned 1 : 0.6 : 1 : 0.7, first vein ending at basal two-fifths of the wing, fourth vein terminating conspicuously beyond the tip of the wing, anterior cross-vein located at three-fifths the length of the discal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein, 1 : 0.9, marginal cilia short.

One specimen: Lafayette, Indiana, July 4, 1914. (Melander).

Drapetis diversa, sp. nov.

♂. 1.3 mm. Black, shining, hairs very short and pale, first four longitudinal veins curving forward, the first vein very short, hind femora with two discoid processes above. Head higher than wide, orbits not pollinose, front very narrow, its sides scarcely converging beneath, face linear, black, cheeks very narrow; palpi and proboscis black; antennæ short, the second joint without a seta beneath, the third joint oval, but slightly longer than wide, the bare arista nearly terminal, one and two-thirds times as long as the antennæ. Mesonotum with short close pubescence, the marginal bristles small, two scutellar, about eight rows of fourteen acrostichals; pleuræ not pollinose. Abdomen subshining, laterally subopaque, hypopygium large, the lamellæ with coarse brown hairs. Legs devoid of bristles, the hairs pale, the hind femora greatly swollen above and bearing a strong backward-projecting hook on the proximal fourth of its extensor surface, distal to which near the middle is a prominent disk-shaped protuberance. Halteres yellowish. Wings short, broad, hyaline, veins pale brown, first vein ending before the middle of the wing, the marginal cell broad, the second, third and fourth sections of the costa proportioned 1.2 : 1 : 1, fourth vein ending slightly before the tip of the wing, the first posterior cell much the widest at its end, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 5, of the fifth vein equal, costa bare, cilia of the hind margin short.

One specimen: Alamogorda, New Mexico.

Drapetis flavicornis, sp. nov.

♀. Length 1 mm. Shining black, the appendages yellow. Head globular, black, subshining, sides of the front slightly diverging above, face linear, shining black, the narrow cheeks, palpi, palpal seta, proboscis, antennæ and arista yellow; antennæ three-jointed, the last joint oval, slightly longer than wide, the arista twice the length of the antennæ and microscopically hairy; ocellar and vertical bristles black. Thorax broader than long, its bristles blackish, its hairs moderately sparse, short and brown; pleuræ polished; abdomen opaque blackish, the middle three segments with two transverse rows of converging setulæ; ovipositor yellowish. Legs without bristles, the hind tibiæ with a broad blunt sericeous terminal lappet. Halteres yellow; calypteres brown. Wings narrow, clear hyaline, veins brownish along the middle of the wing, at the base and apex pale yellowish, the second, third and fourth costal sections proportioned 1 : 1.5 : 0.8, third vein straight, nearly parallel with the fourth, posterior cross-vein somewhat oblique, located before the end of the first vein, sections of the fourth vein proportioned 1 : 0.5 : 3.2, of the fifth vein, 1 : 0.7, marginal cilia as long as the anterior cross-vein.

Type; Le Chorrera, Panama, collected by August Busck, May 12, 1912, for the U. S. National Museum. A male from Jamaica differs only in the following characters which are probably sexual and not specific differences. Pedicel of the second and third veins broadened disc-like and black; hind femora with a strong curved yellow bristle underneath at the outer fourth; mesonotal hairs longer; abdominal setulæ less pronounced.

Drapetis inermis, sp. nov.

♂. Length 1.9 mm. Head black, occiput subshining, front very narrow, its sides converging so as almost to touch, eyes separated below the antennæ by a line, ocellar and vertical bristles moderately long; palpi white and with an apical white hair, proboscis short, reddish; antennæ horizontal, without seta beneath, the third joint lanceolate, nearly twice as long as broad, its terminal arista less than two times the length of the antenna. Thorax shining black, the hypopleuræ alone pollinose, its pubescence white, uniformly distributed, six rows of about eight acrostichals, lateral scutellar bristles small. Base of abdomen not chitinized, the middle segment laterally with a few flattened setulæ; hypopygium shining black, with few hairs. Legs largely brownish, the anterior femora and coxæ and the base of the hind femora yellowish, middle femora alone with a preapical bristle, hind tibiæ with a single extensor bristle located just above the middle, its apex merely callous, metatarsi not setulose. Halteres yellow, calypteres with six cilia. Wings narrow, nearly hyaline, the veins strong and dark, marginal cilia minute, the second, third and fourth sections of the costa proportioned 1.6 : 2.4 : 1, the submarginal cell at the end of the first vein one-half as wide as the marginal, and at the end of the second vein equal in width to the first posterior, third and fourth veins subparallel, the first posterior cell widest beyond the end of the second vein, anterior cross-vein just before the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 2.5, of the fifth vein, 3 : 1.

One specimen, Alhajuelo, Panama, April 11, 1911, collected by August Busck for the U. S. National Museum.

Drapetis infumata, sp. nov.

♀. Length 1.6 mm. Shining black, mesonotum densely black-setulose, wings infumated. Front broadly V-shaped, at the bottom nearly as wide as the second antennal joint; face narrow, its sides parallel; palpi blackish, with a few dusky hairs; antennæ ascending, the lowermost hair of the second joint setiform, the third joint very short, ovate, the subapical nearly bare arista more than three times as long as the antennæ. No humeral, three or four supraalar, four scutellar, two small prescutellar bristles. Abdomen subshining blackish. Legs blackish, the posterior femora with a small preapical bristle, no tibial bristles, or apical spur. Halteres black. Wings oval, the second, third and fourth sections of the costa proportioned 1.3 : 1.8 : 1, third and fourth veins subparallel, the first posterior cell a little the widest before its tip, anterior cross-vein before the middle of the discal cell, segments of the fourth vein proportioned 1 : 2.3, of the fifth vein, 1.6 : 1, marginal cilia uniformly short.

Type specimen: Nelson, British Columbia, July 17, 1910. Paratype: Priest Lake, Idaho, August 1, 1915 (Melander). In author's collection.

Drapetis micropyga, sp. nov.

♂. Length, 1.5 mm. Black, shining, legs simple without bristles, black, the front coxæ and knees brown, antennæ short, halteres black, third and fourth veins nearly parallel. Head round, orbits shining, bottom of the front one-half as wide as the second joint of the antennæ, face linear, cheeks obliterated, proboscis very short, palpi blackish, brown-hairy and without an apical seta; second antennal joint without seta beneath, the third joint short oval, not longer than wide, the subterminal arista slender, twice as long as the antennæ. Pubescence of the mesonotum short and dense, no discal bristles, the lateral bristles confined to three or four in front of the root of the wings, lateral scutellars small; pleuræ with tomentum in front of the wings and beneath the humeri. Abdomen subshining, nearly bare, hypopygium small, rounded, closed, with uniform short, brown hairs. Wings hyaline, the second, third and fourth sections of the costa proportioned 1 : 1.5 : 1, first posterior cell slightly widening toward the tip, fourth vein ending beyond the apex of the wing, its outer two sections proportioned 1 : 7, sections of the fifth vein equal, anterior cross-vein at two-thirds the length of the second basal cell, marginal cilia uniformly short.

Pullman and Almota, Washington: Moscow Mountain, Idaho. A male from Washington, D. C., does not offer any differences.

Drapetis naica, sp. nov.

1.2 mm. Black, with simple black legs, third vein curving forward, first vein ending near the middle of the wing, hypopygium small. Head higher than wide, orbits not pollinose, front, face and cheeks very narrow, palpi yellowish, the terminal hair pale, proboscis short, black; antennæ short, ascending, the second joint without a seta beneath, the third joint ovate, one-fourth longer than broad, the slender terminal arista one and three-fourths times the antennal length. Thorax with uniform, short, fine, brown hairs, about eight rows of eighteen acrostichal hairs, no humeral, three supraalar, four scutellar, bristles; pleuræ polished; abdomen shining, the sides of the middle segments subopaque and with brown setulæ; hypopygium small, rather triangular in profile, its valves not open. Front coxæ and knees brownish, posterior femora with a single preapical bristle, spur of the hind tibiæ long but blunt, metatarsi not setulose. Halteres blackish. Wings hyaline, veins brown and thin, the first four veins curving forward, first vein ending near the middle of the wing, the second, third and fourth sections of the costa proportioned 1 : 1.2 : 1, fourth vein ending beyond the tip of the wing, its outer two sections proportioned 1 : 6, anterior cross-vein at two-thirds the length of the second basal cell, costa and hind margin uniformly short-ciliate.

Various places in Washington, Idaho, New Mexico and Texas.

Drapetis pilosa, sp. nov.

Length 1.25 mm. Black species with halteres and the major portion of the legs black. Head almost spherical, front V-shaped, dusted, ocelli large, face linear; mouthparts black, no long palpal hairs; occiput lightly dusted, orbits not differentiated, cheeks linear; antennæ one-third the head-height, ascending, the second joint not setigerous, the third joint triangularly ovate, scarcely longer than deep, the arista subterminal, three-fourths longer than the antenna. Mesonotum shining, the hairs relatively long, conspicuous and obliquely erect, no humeral, one dorsocentral, one intraalar bristle, only the apical pair of scutellar bristles long; pleuræ polished. Abdomen shining, disc bare, lateral hairs short, stiff and black, last segment without long fringe, fourth segment much longer than any of the others; hypopygium small, transversely depressed, the parts on the right side slightly exposed. Legs entirely bristleless, no tibial lappet or spurs, front tibiæ and all the tarsi yellowish-brown. Hairs of calypteres black. Wings hyaline, veins very thin, brownish, the first vein ending at the middle of the wing, sections of the costa proportioned 1 : 0.4 : 0.7 : 0.3, of fourth vein, 0.3 : 0.2 : 10, third vein sinuate and apically parallel with the fourth, sections of fifth vein subequal.

♀, thoracic pubescence slightly shorter than in ♂.

Type: Lafayette, Indiana, July 4, 1914 (Melander). Four paratypes, Chicago, Illinois, June 28, 1914, on shrubbery in vacant lots near the lake shore (Melander).

Drapetis setulosa, sp. nov.

Length 1.3 mm. Shining black, hairs of the mesonotum numerous and black, legs yellowish. Occipital and ocellar bristles stout, lower part of the front one-third as wide as the second antennal joint; palpi blackish, but covered with white hairs; eyes together higher than broad, obliterating the cheeks; antennæ short, ascending, no seta beneath, the third joint short-ovate, with nearly bare subterminal arista measuring three times the antennal length. Mesonotum shining, densely short-hairy; no humeral, five supraalar bunched together, two small prescutellar, two scutellar bristles. Abdomen sub-shining black, hypopygium small, rounded, apically with numerous short yellowish hairs. Legs short, yellowish to brown, the front ones lighter, the hind ones darker, no bristles or terminal spur. Halteres blackish. Wings hyaline, third vein lightly sinuose, parallel with the fourth toward its end, the fourth vein with a downward curve in the middle of the wing, then straight, the second, third and fourth sections of the costa proportioned 1.2 : 1.8 : 1, submarginal cell as wide as the marginal and the first posterior opposite the ends of the first and second veins respectively, anterior cross-vein near the middle of the second basal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein equal, marginal cilia uniformly short.

Two specimens: Pullman and Almota, Washington, June. A specimen in the U. S. National Museum from South Fork, British Columbia, has the third vein a little closer to the fourth.

Drapetis trichura, sp. nov.

♂. Length 1.4 mm. Black, legs yellowish, hairs black and abundant, the last tergite, apex of hypopygium and of the apical lamella with numerous bristly hairs. Front V-shaped, eyes nearly meeting just above the antennæ and on the middle of the face; cheeks narrow; vertical and ocellar bristles short, upper occiput setulose; antennæ ascending, short, black, no seta beneath, the third joint not longer than broad, ovate, with a subterminal arista nearly bare and measuring two and one-half times the antennal length; palpi white and with straggling white hairs, proboscis very short. Mesonotum shining, densely hairy, about ten rows of setulæ between the dorsocentral rows; no humeral, three notopleural, two dorsocentral, four scutellar bristles; abdomen opaque blackish, hypopygium polished jet black. Legs short, simple, without true bristles on the femora or tibiæ, no apical spur on the hind tibiæ. Halteres blackish. Wings hyaline, the third vein with a strong anterior curve, fourth vein nearly straight but with a slight posterior curve at the middle of the wing, the submarginal cell opposite the end of the first vein two-thirds as wide as the marginal, and at the end of the second vein two-thirds as wide as the first posterior cell, anterior cross-vein at two-thirds the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 10, of the fifth vein equal, costa and hind margin uniformly short-ciliate.

One specimen: Austin, Texas.

Eudrapetis armata, sp. nov.

Length 1.8 mm. Black, shining, with black legs, the femora with a single preapical bristle, front femora ♂ above along the middle with a group of about six spines, reduced in the ♀ to one or two, hind tibiæ with two short extensor bristles located at the middle and about half way to the tip, the apical spur small. Front subshining, at the bottom two-thirds as wide as the second antennal joint, face half as broad as this joint, its sides diverging below, subshining black, cheeks broader behind where they are about one-fifth the eye-height; palpi black but the front surface white pruinose, the apical hair black, proboscis black; antennæ elongate, ascending, the second joint with a seta beneath, the third joint lanceolate, about twice as long as broad, its terminal arista rather heavy with close short pubescence, measuring one and two thirds times the antennal length. Thorax ♂ nearly bare, narrowly tomentose before the scutellum and around the root of the wing and conspicuously so below the humeri; pleuræ shining; one strong humeral, four supraalar, one intraalar almost posthumeral in position, two prescutellar, four scutellar, the lateral ones short; in the ♀ the notal hairs are long, fine, abundant and whitish, the lateral bristles are shorter and the subhumeral region is provided with white hairs instead of tomentum. Abdomen shining, nearly bare, in the ♂ the hairs are blackish and stronger, along the sides of the middle segment slightly flattened, hypopygium short, rather small, its appendages open above. Legs sometimes more or less reddish near the end of the hind tibiæ, the hind metatarsi not setulose, apical spines of the anterior tibiæ long. Halteres white, calypteres with about eight dusky cilia. Wings yellowish hyaline, veins pale brown, first posterior cell rather broad, its veins parallel outwardly, the second, third and fourth sections of the costa proportioned 1.3 : 1.3 : 1, anterior cross-vein at three-fourths the length of the second basal cell, outer two sections of the fourth vein proportioned 1 : 7, of the fifth vein equal, marginal cilia uniformly short.

Numerous specimens from Washington, Idaho, Massachusetts and Maine. One specimen from Olga, Washington, has three extensor bristles on the hind tibiæ.

Eudrapetis discalis, sp. nov.

♂. Length 1.4 mm. Shining black, closely pubescent, legs yellow, posterior cross-vein at the middle of the wing. Occiput with short, brownish hairs and bristles; front V-shaped, at the bottom one-half as wide as the second antennal joint, face and cheeks linear; palpi blackish with a few brown hairs, proboscis short, black; antennæ ascending, the second joint with a seta, the third joint short-ovate, the subterminal arista slender, bare, over three times the antennal length. Hairs of the thorax short, dense, pale, no humeral, three supraalar, four scutellar bristles. Sides of the abdomen subopaque, with white pubescence, disk shining, hypopygium elongate, outwardly with white hairs. Legs slender, the hind femora with short preapical bristles, no tibial bristles or spur. Halteres blackish. Wings hyaline, veins narrow, brownish, third and fourth veins subparallel, the third lightly sinuose, so that the first posterior cell is widest before its apex, second, third and fourth sections of the costa proportioned 1.4 : 1.8 : 1, anterior cross-vein at two-fifths the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 1.8, of the fifth vein, 2 : 1, marginal cilia uniformly very short.

Two specimens: Wawawai, Washington, and Palo Alto, California.

Eudrapetis diversipes, sp. nov.

♂. Length 1.9 mm. Black, shining, legs yellowish, the hind femora and metatarsi blackish, hairs of the thorax rather sparse, fine and pale, hypopygium very large. Vertex, front and face grayish black, vertical and ocellar bristles large, front beneath nearly as wide as the second antennal joint, face very narrow, linear beneath, occipital orbits grayish, cheeks broader behind where they are one-tenth the eye-height; palpi brownish, with apical black hair, proboscis brown; antennæ black, the second joint with a long seta beneath, third joint broken. Four rows of about nine acrostichals, no discal bristles, two scutellars; pleuræ not pollinose. Abdomen shining, nearly bare, hypopygium with very sparse whitish hairs, the right lamella large, broad and deeply cleft. Legs luteous, the hind coxæ, femora and metatarsi blackish, pubescence whitish, anterior femora with a single preapical, the hind femora with two preapical bristles, anterior tibiæ with a pair of apical spines, those of the hind tibiæ small, its apical spur rather strong and pointed, no extensor bristles on the tibiæ, hind metatarsi not setulose. Halteres whitish. Wings hyaline, veins pale brown, the fourth vein very slightly undulate, apically parallel with the third vein, the second, third and fourth sections of the costa proportioned 1.6 : 1.6 : 1, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein equal, marginal cilia uniformly very short.

One specimen: Santa Cruz Mountains, California, received from Professor R. W. Doane.

Eudrapetis dorsiseta, sp. nov.

♀. Length 2 mm. Shining black, the spur of the hind tibiæ and the matted pubescence of the hind metatarsi brown. Second antennal joint with a long seta beneath, third joint ovate, scarcely longer than broad, the arista arising before the end of the third joint, slender, loosely microscopically hairy, measuring three times the antennal length; face linear, white-pollinose, clypeus shining, cheeks narrow in front, broad behind, lower orbits white-pollinose. Dorsum of the thorax loosely hairy, five hairs in the dorsocentral rows a little longer; halteres yellow. All the femora with a single preapical bristle, front tibiæ with one strong preapical flexor bristle, hind tibiæ with five erect extensor bristles which in length are equal to the diameter of the tibiæ but the apical one longer, on the outer side with two short, strong, apical spines and on the inner side with a strongly projecting, broad, blunted spur, hind metatarsi somewhat swollen, not bristly except for one apical setula. Wings narrow, long, hyaline, the veins coarse and black, first vein ending at the middle of the wing, the second, third and fourth sections of the costa proportioned 3.5 : 3.7 : 1, third and fourth veins mutually converging at the tip, anterior cross-vein at three-fifths the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 7, of the fifth vein 4 : 3, margin with short cilia.

One specimen: Juan Vinas, Costa Rica, collected by Dr. P. P. Calvert for the Philadelphia Academy of Science.

Eudrapetis facialis, sp. nov.

Length 1.5 mm. Broad, black, shining, mesonotum with dense, white hairs and with erect dorsocentrals on the disk, face white-pruinose, legs yellowish. Posterior orbits white-pruinose, front opaque black, as broad as the second antennal joint, face relatively broad, narrowest in the middle, cheeks obliquely descending in back, one-ninth the eye-height; palpi yellow, proboscis blackish; antennæ black, ascending, the second joint with a seta beneath, the third joint lanceolate, one-half longer than wide, the arista terminal, slender, twice as long as the antennæ. Pleuræ pollinose posteriorly and more or less along the sutures; abdomen shining except along the extreme sides, its hairs sparse, white, hypopygium small, globular. Legs luteous, the hind metatarsi dark, anterior femora with one preapical, hind femora with two, hind tibiæ without extensor bristles but with one pair each of short, stout preapical and apical bristles. Halteres pale yellow; calypteres fringed with six fine white cilia. Wings hyaline, veins pale brown, third and fourth veins converging, the second, third and fourth sections of the costa proportioned 2 : 2 : 1, anterior cross-vein at two-thirds the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 4, the outer section of the fifth vein shorter than the preceding, margin uniformly short-ciliate.

Two specimens: Okefenokee Swamp, Georgia, June, received through Professor O. A. Johannsen of Cornell University; and Medicine Hat, Alberta, collected by J. R. Malloch and deposited in the U. S. National Museum.

Eudrapetis nitens, sp. nov.

♀. Length 1.4 mm. Head and body entirely jet black, the legs dark brown, the halteres white. Face linear, front narrowly V-shaped, at the bottom nearly as broad as the width of an antennal joint; lower third of orbits pollinose, occiput, vertex, front and oral margin polished; palpi and proboscis black, the former cinereous pubescent; second antennal joint bisetose below, third joint short oval, the arista slender, microscopically sparsely pubescent, and two and a half times as long as the antenna. Thorax entirely polished, the notal hairs moderate in length and density, the central and distant two scutellar bristles alone long. Hairs of hind tibiæ rather long, four pronounced preapical but no extensor bristles present, the apical lappet strong. Wings lightly infumated, veins strong and blackish, costal sections approximately 1 : 0.6 : 0.8 : 0.3, third and fourth veins converging at apex, sections of fourth vein as 0.5 : 0.4 : 1.8, of fifth vein, 4 : 5.

Type: Panama, March, 1915, received from Dr. A. H. Sturtevant. Paratypes from Havana, Cuba (Sturtevant, and Orizaba, Mexico, (Wm. M. Mann, in Museum of Comparative Zoology) differ in having the legs usually quite black, the posterior occiput slightly pollinose and the mesonotal hairs sparse. A male from Aquada, Panama (Sturtevant), has brown legs and wing-veins. The hypopygium is globose but not larger than the abdomen.

Eudrapetis nuda, sp. nov.

Length 1.6 mm. Shining black, pubescence pale, short and very fine, legs devoid of bristles, yellow, the hind femora largely black. Occipital orbits white-pollinose; eyes separated above the antennæ nearly as much as the width of the second antennal joint, front subshining black; face gray, linear in the middle, cheeks one-tenth the eye-height, their lower edge horizontal; palpi white and with a terminal white hair, proboscis brown; basal joints of the antennæ yellow, the second joint with a seta beneath, the third joint lanceolate, fuscous, two-thirds longer than broad, with short pubescence, the terminal arista nearly bare, two times the antennal length. Thorax closely covered with short and very fine white hairs, no evident dorso-centrals on the disc, four scutellars, pleuræ with gray tomentum following the notopleural and the meso-sternopleural sutures. Abdomen subopaque black, its short sparse hairs black, hypopygium of moderate size, shining, with white hairs beneath, the left side with a trifurcate process. Legs simple, without spines or bristles, hind tibiæ not spurred, the last tarsal joint a little darker. Halteres yellowish. Wings hyaline, veins thin, brownish, the third and fourth veins rather strongly convergent, the fourth vein curving forward toward its tip, second vein shorter than usual, the second, third and fourth sections of the costa proportioned 1.3 : 4.5 : 1, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein subequal, marginal cilia uniformly short.

Numerous specimens: Kamerun, West Africa, received from Professor Roland Thaxter.

Eudrapetis œdimera, sp. nov.

♂. Length 1 mm. Shining black, with brown legs, black antennæ, blackish palpi, dirty white halteres and strong dark brown veins; hind femora with a pronounced swelling beyond the middle of the anterior face. Second antennal joint with a long inferior seta, third joint short, oval, scarcely longer than wide, its arista long and slender, measuring four times the antennal length, microscopically hairy. Vertex broadly polished, ocellar triangle prominent, occiput slightly dusted, the lower orbits and the lower front only inconspicuously cinereous, face linear, black. Hairs of mesonotum very sparse, brownish, those of the dorsocentral rows long, scutellum somewhat dusted; pleuræ entirely polished; abdomen nearly bare, largely shining, pygidium small, elliptical in outline, sparsely hairy. Anterior tibiæ with fine apical bristles, hind femora with two apical bristles on the anterior side, hind tibiæ without extensor bristles but with a group of three at the tip, metatarsi not setulose. Wings hyaline, veins broad, the fifth vein evanescent midway between the posterior cross-vein and the margin, first four veins with a slight anterior curvature, the third and fourth veins nearly parallel, second, third and fourth sections of the costa proportioned 1 : 1.4 : 0.6, anterior cross-vein at three-fourths the length of the discal cell, the posterior cross-vein a little before the end of the first vein, fourth vein ending at the wing-tip, its sections proportioned 3 : 1 : 9, basal section of the fifth vein slightly longer than the outer, marginal cilia much longer than the anterior cross-vein, nearly as long as the posterior cross-vein.

One specimen, in the U. S. National Museum. Cordoba, Vera Cruz, Mexico, May 13, 1908, collected by Dr. A. Fenyes.

Eudrapetis parvicornis, sp. nov.

♂, ♀. Length 1.2 mm. Black, shining, the hairs fine, sparse and yellowish. Occiput and front opaque black, eyes separated on the face by a narrow line of pollen, antennal incision deep, front at bottom as broad as the base of an antenna; ocellar and vertical bristles strong; palpi black but white pruinose; antennæ short, black, the second joint with a long seta beneath, the third joint rounded oval, no longer than the second joint, its terminal arista nearly bare. No humeral, two small prescutellar dorsocentral, two scutellar bristles; pleuræ polished. Pygidium large, ovate, closed, its hairs short, sparse and pale. Legs black, the under side of the anterior femora reddish brown, hind femora with two preapical bristles, hind tibiæ with three apical bristles and with a strong spur, but without extensor bristles. Halteres fuscous, calypteres margined with six cilia. Wings short and broad, lightly infumated, the veins coarse and dark, margin uniformly short-ciliate, second, third and fourth sections of the costa proportioned 1.7 : 1.8 : 1, third and fourth veins outwardly subparallel, anterior cross-vein at the outer third of the second basal cell, the last two sections of the fourth vein proportioned 1 : 9, of the fifth vein equal.

Three specimens: Pullman, Washington, March 5, (Melander), and Rock Creek, D. C., March 9 (R. C. Shannon). Paratype in U. S. National Museum.

Eudrapetis pennescens, sp. nov.

♀. Length 2.25 mm. Differing from *armipes* Bezzi in the following respects: Legs blacker, the hind femora with only one pronounced knee bristle, the hind tibiæ with five or six long contiguous hair-like bristles forming a feather-like row along the middle of the inner side and with a strong terminal lappet and stout subapical bristles, the hind metatarsi with blackish and not golden pubescence; wings clear hyaline. Differing from *plumipes* in being larger and more robust and in having the mesonotum closely white-pubescent, the hind femora with a single knee bristle and the wings hyaline.

Shining black, pubescence white, bristles black, the narrow front, linear face and lower orbits cinereous pruinose; legs almost black, the hind tibiæ dark brown; halteres white; veins black and strong. Palpi blackish, oral margin polished, seta of the second antennal joint strong.

Second and third sections of the costa subequal, third and fourth veins converging, outer part of the fifth vein abruptly weak, sections of the fourth vein proportioned 3 : 2 : 9, of the fifth vein equal.

One specimen: Matucana, Peru, collected by C. T. Brues, July 1, 1913.

Eudrapetis plumipes, sp. nov.

♀. Length 1.2 mm. Black, legs blackish, the hind tibiæ with long, feathery, flexor hairs and with a strong terminal lappet, halteres yellow, third and fourth veins convergent. Sides of the pollinose front nearly parallel, face linear, whitish, upper occipital orbits polished, lower orbits pruinose, ocellar bristles large and black; palpi brown, without setæ, proboscis black; second antennal joint with a long seta beneath, third joint oval with the arista subterminal, microscopically and closely hairy and more than three times the length of the antennæ. Thorax glistening black, only a narrow pruinose line extending from the middle coxæ to the halteres, pubescence long and very sparse, about five short dorsocentrals visible; hairs of the abdomen rather long. Anterior tibiæ with two terminal bristles, hind femora with two strong preapical bristles, hind tibiæ with three preapical bristles on the exterior side opposite the sharp lappet, hind metatarsi black. Wings somewhat infumated, veins coarse, blackish, basal bristle long, the second, third and fourth sections of the costa proportioned 1 : 1.2 : 0.4, first posterior cell distinctly widest at its outer third, sections of the fourth vein proportioned 1 : 0.3 : 3.2, of the fifth vein, 1 : 0.9.

Type specimen: Austin, Texas. Paratype, Kushla, Alabama, received from Dr. A. H. Sturtevant. Paratype, Orizaba, Mexico, collected by Wm. M. Mann and deposited in the Museum of Comparative Zoloogy of Harvard University.

Eudrapetis quadrisetosa, sp. nov.

♂. Length 2 mm. Jet black, the halteres whitish. Face linear, pollinose; front V-shaped, nearly shining, at the lowest part nearly as broad as an antennal joint; upper orbits and vertex polished, lowest third of the orbits white pruinose, oral margin broadly shining black; proboscis and palpal ground-color black; second antennal joint with one long bristle beneath, third joint short ovate, the slender subterminal arista nearly three times the antennal length. Notal hairs long, fine, brown and rather abundant, scutellum with an extra pair of long, apical bristles making four long equidistant scutellars in addition to the minor lateral pair. Abdomen with sparse golden hairs; pygidium globose, not swelling the abdomen. Legs sturdy, nearly black, hind tibiæ more brown, hind metatarsi darker than the adjacent joints, front tibiæ with two apical spurs, hind tibiæ without extensor bristles but with two short but stout preapical spurs, the terminal lappet strong, hind metatarsi scarcely visibly setulose. Wings subhyaline, veins dark but narrow, costal sections proportioned 1 : 0.6 : 0.8 : 0.2, third and fourth veins slightly convergent, sections of the fourth vein, 0.6 : 0.5 : 2.1, of fifth vein equal.

Type: San Jose, Costa Rica, Central America, March, 1915, received from Dr. A. H. Sturtevant. Paratypes from same locality and from Orizaba, Mexico (Mann and Skewes), the last in the Museum of Comparative Zoology, Harvard University.

Drapetis scissa, sp. nov.

Drapetis medetera Melander, in part, Tr. Am. Ent. Soc. xxviii. 208 (1902).

Length 1.7 mm. Shining black, thorax with black hairs and discal dorsocentrals; extensor bristles, apical spines and spur of hind tibiæ small; antennæ elongate; halteres white; third and fourth veins slightly converging toward tip. Head round, occipital orbits grayish black, bottom of the shining black front two-thirds as wide as the second antennal joint, face black narrowed in the middle where it is nearly one-half as wide as the second antennal joint, cheeks scarcely deepened behind, one-tenth the eye-height; palpi black, but overlaid with gray, proboscis black; antennæ ascending, second joint with a seta beneath, third joint lanceolate, three-fourths longer than broad, the terminal arista one and three-fourths the antennal length. Pubescence of the thorax fine and rather sparse, six rows of about ten acrostichals, five or six long, slender dorsocentrals, one humeral, one intraalar, two notopleural, three supraalar, four scutellar bristles; a little pollen before the scutellum, pleuræ shining. Abdomen shining, its hairs pale and long, hypopygium of moderate size. Legs black, the pubescence pale, anterior femora with one, hind femora with two preapical bristles, extensor bristles of hind tibiæ located beyond the middle and near the apex, metatarsi not setulose. Halteres white, calypteres with eight pale cilia. Wings broad, hyaline, veins pale brown, the second, third and fourth sections of the costa proportioned 1.4 : 2 : 1, anterior cross-vein at three-fourths the length of the second basal cell, outer two sections of the fourth vein proportioned 1 : 5, of the fifth vein equal, first posterior cell widest before its end, marginal cilia uniformly small.

Clayton, Washington; Oxford, Idaho; Hunter's Creek and Rock River, Wyoming, the last from the collection of the University of Kansas.

Eudrapetis septentrionalis, var. **mexicana,** var. nov.

♂. A shining black species with yellowish legs, the hind femora blackened apically, especially along the posterior side, hind metatarsi blackish, palpi yellow. Head higher than long, the lower front, the narrow face and the lower orbits silvery pruinose. Pubescence of the body yellowish, about four longer hairs in the dorsocentral rows. Veins pale brown, posterior cross-vein before the end of the first vein, second to the fourth sections of the costa proportioned 1 : 1.2 : 0.6, sections of the fourth vein, 1 : 0.4 : 3.3, of the fifth vein, subequal, marginal cilia a little longer than the anterior cross-vein.

One specimen, in the U. S. National Museum. Collected by F. C. Bishopp, at Tampico, Mexico, December 6.

Eudrapetis spinipes, sp. nov.

Length 1.6 mm. Body polished black, very sparsely hairy, legs luteous, hind tibiæ with several black spinous bristles toward its apex. Front broadly V-shaped, gray pollinose, at the bottom nearly as wide as the second antennal joint, eyes subcontiguous at the middle of the face, lower occiput white-pruinose, cheeks broad, their greatest diameter one-fifth the eye-height; palpi broad, yellowish, with a single apical hair, proboscis nearly as long as the eye-height, brown; antennæ black, the second joint with a long seta beneath, the third joint oval, slightly longer than broad, the slender subterminal arista loosely microscopically pubescent. The very sparse and short hairs of the thorax black, no dorsocentrals, two scutellars; pleuræ entirely polished. Abdomen shining black, its sparse hairs brown; hypopygium small, closed, beneath with white hairs. Legs including the coxæ and ends of the tarsi entirely yellow, anterior femora with a single preapical, hind femora with two preapical bristles, anterior tibiæ tipped with a pair of long, black spines, hind tibiæ at two-thirds their length with a long flexor spine, beyond which on the outside are two preapical and two apical spines, all long, on the inside the short broad apical spur is strong, metatarsi not setulose beneath. Halteres yellow. Wings brownish, veins narrow but firm, the third and fourth veins subparallel, the first posterior cell widest before its apex, the second, third and fourth sections of the costa proportioned 1.6 : 2.4 : 1, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 9, of the fifth vein subequal, marginal cilia uniformly short.

Numerous specimens: Kamerun, West Africa, received from Professor Roland Thaxter.

Ctenodrapetis aristalis, sp. nov.

♂, ♀. Length 1.4 mm. Head glistening black, thorax reddish, abdomen largely or completely black, legs yellow. Front very narrow, eyes contiguous below the antennæ, vertical and ocellar bristles long; basal joints of the antennæ short, yellow, without bristles beneath, the third joint elongate, bluntly oval, thickly black-pubescent, the terminal arista twice as long as the antennæ, with dense black pubescence, so as to appear nearly as thick as the antenna itself. Palpi white; proboscis yellow. Thorax polished reddish yellow, the scutellum and metanotum brown, not pubescent, five pale dorsocentrals, the hindmost long, two scutellars. Abdomen with scattered pale hairs, those of the last segment long, apex of the four basal segments sometimes whitish; hypopygium longer than broad, with few hairs and with asymmetrical appendages visible. Legs slender, including the coxæ pale yellow, the anterior tibiæ and tarsi a little darker, hind tibiæ with only a slight apical swelling and with a single extensor bristle located at the middle, anterior femora with a fine basal hair beneath and all the femora with a preapical bristle on the front side. Halteres white; calypteres white and with four long, pale hairs. Wings clear hyaline, veins yellowish, the outer half of the fourth and fifth veins darkest, costa provided with long, isolated hairs only on the basal half; in outline the wings are narrow, especially on the proximal portion, the anal angle almost entirely reduced; third section of the costa slightly longer than the second, and two and one-half times as long as the fourth section, third vein lightly sinuose, diverging from the fourth and with an anterior curve at its very apex, the submarginal cell beyond the second vein as wide as the first posterior, the anterior cross-vein short, located at three-fifths the length of the second basal cell, last two sections of the fourth vein proportioned 1 : 5, of the fifth vein, 5 : 3; marginal hairs long.

Thirty-five specimens: Manila, Philippine Islands, Robert Brown, collector, from the U. S. National Museum.

Ctenodrapetis cuneipennis, sp. nov.

♀. Length 1.5 mm. Head globular, occiput glistening black, nearly bare, the vertical and ocellar bristles rather short, front narrow, its sides parallel, eyes contiguous below the antennæ; antennæ yellowish, without bristles beneath, the third joint slightly darker, bluntly lanceolate and densely short-pubescent, two and one-half times as long as wide, the terminal arista one and one-half times the antennal length, bushy with dense black pubescence so as to appear nearly as thick as the antenna itself. Palpi white; proboscis yellow. Thorax flavous, including the scutellum, metanotum and pleuræ, but with a brown spot above the root of each wing. The four basal segments of the abdomen whitish with very narrow, brown sclerites, the tergite of the fifth segment large, corneous and brown. Halteres white; calypteres with two pale hairs. Legs slender, pale yellow, the hind tibiæ with small apical spur and with two extensor bristles near the middle. Wings slender, hyaline, the veins pale, the anal angle very greatly reduced, the third section of the costa twice as long as either the second or the fourth, the third vein lightly sinuous and diverging from the fourth so that the submarginal cell is not nearly so broad as the first posterior, anterior cross-vein short, located before the middle of the second basal cell, the last two sections of the fourth vein proportioned about 1 : 3, of the fifth vein, 5 : 3, marginal hairs long.

One specimen: Manila, Philippine Islands, Robert Brown, collector; in the U. S. National Museum.

Elaphropeza calva, sp. nov.

1.5 mm. long. Shining yellow species with yellow legs, the occiput polished black, the middle segment of the abdomen blackish; middle tibiæ denticulate within, spur of the hind tibiæ short, posterior cross-vein at the middle of the wing. Antennæ entirely yellow, the third joint ovate, one-half longer than broad, the arista microscopically pubescent and three times as long as the antennæ; front narrow, shining, face linear; occiput with a little pollen near the neck, the yellow hairs and bristles prominent; mouthparts yellow. Hairs of the thorax long but sparse, scutellum and metanotum reddish brown; base and apex of the abdomen testaceous yellow, the pygidial valves rather large, lateral hairs of the middle segment scale-like. Legs hairy and moderately stout, the middle femora a little the strongest, front femora not setose, the distance between the bristles of the hind tibiæ less than one-third the length of the tibiæ, the terminal spur small and yellow. Wings narrow, more than three times as long as broad, veins yellow, second, third and fourth sections of the costa proportioned 1 : 1.8 : 0.8, sections of the fourth vein, 1 : 1 : 2.3, of the fifth vein, 1 : 0.4.

Six specimens: Corazal, Panama, and Motzorongo, Vera Cruz. Type in the U. S. National Museum.

Elaphropeza comata, sp. nov.

♂. Length 1.75 mm. Head black, thorax entirely reddish, middle segments of the abdomen blackish, hairs and bristles pale, hind legs loosely pectinate. Front very narrow, almost linear; antennæ fuscous, without seta beneath, the third joint lanceolate, two times as long as broad, the arista twice as long as the antennæ, with short pubescence; palpi and proboscis yellow. Thorax rather hairy, four rows of about seven acrostichals, two scutellar bristles. Middle segment of the abdomen with many flattened setulæ, last tergite with long hairs, hypopygium elongate, with numerous hairs at apex and below. Legs yellow, the last tarsal joint dark, middle femora alone with preapical bristle, hind tibiæ without long extensor bristles, but instead with a series of about ten shorter, regularly placed, erect bristles, similarly the hind metatarsi provided with seven erect extensor bristles, spur of hind tibiæ very small and blunt. Halteres dusky, calypteres with eight dusky cilia. Wings rather broad, clear hyaline, the veins brown, the second, third and fourth sections of the costa proportioned 1.6 : 2.5 : 1, the third and fourth veins nearly straight, very slightly converging apically so that the widest part of the first posterior cell is just beyond the termination of the second vein, anterior cross-vein before the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 2, of the fifth vein, 3 : 1.

One specimen: Trinidad Island, West Indies, collected by August Busck, for the U. S. National Museum.

Elaphropeza inflexa, sp. nov.

Length 1.4 mm. Occiput black, front narrowly V-shaped, at the bottom one-third as wide as the second antennal joint; antennæ rather short, blackish, the second joint without seta, the third joint broadly lanceolate, one-half longer than broad, the arista short-pubescent and one and three-fourths times as long as the antennæ; palpi short, whitish, proboscis red. Thorax, including the scutellum and metanotum luteous, unmarked, the hairs noticeable but scattered, four rows of about six acrostichals. Abdomen blackish, the sides of the middle segment with many minute scale-like setulæ, last tergite fringed but the elongate hypopygium nearly bare. Legs yellow, the front femora with a short preapical bristle, that of the middle femora stronger, hind tibiæ with two extensor bristles trisecting its length and with a short blunt terminal spur. Halteres dirty yellow, calypteres fringed with five cilia. Wings clear hyaline, the second, third and fourth sections of the costa proportioned 1.5 : 2.5 : 1, third vein with pronounced anterior curve, the fourth vein nearly straight, submarginal cell at the end of the first vein nearly as wide as the marginal cell, and beyond the end of the second vein narrower than the first posterior cell, which latter is widest at three-fourths its length, the last two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2 : 1, marginal cilia short.

Four specimens, Canal Zone, Panama, collected by August Busck for the U. S. National Museum. The species is near *formosæ* Bezzi, but has a longer arista.

Elaphropeza læta, sp. nov.

♂, ♀. Length 1.7 mm. Shining yellow, with yellow antennæ, mouthparts and legs, the scutellum, metanotum, abdomen and a prescutellar spot blackish; middle tibiæ denticulate within, front femora not black setose. Head black except the posterior oral margin, occiput cinereous-pollinose, front very narrow, almost linear, shining, eyes of male contiguous below the antennæ, obliterating the face, in the female the eyes are subcontiguous; vertical bristles brown, palpal setæ yellow; third antennal joint ovate, one-half longer than broad, the arista closely but microscopically pubescent, brown, two and a half times as long as the antennæ. Hairs of the thorax moderately abundant and long, bristles yellow. Middle segment of the abdomen darkest, with lateral flattened setulæ, pygidium sericeous. Legs rather slender, front femora sparsely ciliate below, middle femora with strong preapical bristle, not denticulate below, the antero-flexor edge of the hind femora with stiff yellow setæ, six outstanding extensor hairs toward the base of the hind femora, hind tibiæ with a rather strong black terminal lappet, the two extensor bristles separated by less than one-third the length of the tibia. Wings three times as long as broad, veins strong and brown, second, third and fourth sections of the costa proportioned 1 : 1.3 : 0.8, third and fourth veins straight, slightly diverging, sections of the fourth vein proportioned 0.9 : 1 : 2.2, of the fifth vein. 1 : 0.4.

Five specimens: Alhajuelo, Panama; August Busck, collector. Type in U. S. National Museum.

Var. **ungulifera,** new. A male specimen from Corozal, Panama, differs in having the spur of the hind tibia long, very slender and curved, measuring as long as the third tarsal joint. The scutellum is reddish and the prescutellar spot is lacking. The veins are light yellow and not coarse.

Var. **nigrocalcarata,** new. A male specimen from Alhajuelo, Panama, differs in having the spur of the hind tibia very large and broad and black, so it contrasts markedly with the remainder of the legs. The prescutellar spot is lacking but the scutellum is blackish like the metanotum and abdomen. The upper occipital orbits are polished and the veins are only moderately brown. The wings of both variations are less than three times as long as broad. Possibly these specimens represent distinct species. They are deposited in the U. S. National Museum.

Elaphropeza luteicollis, sp. nov.

Length 1.5 mm. Slender, the head and abdomen black, thorax reddish, legs yellow, apex of the tibiæ black, hairs and bristles yellow. Front narrow, its sides slightly converging below, at the bottom one-fourth as wide as the second antennal joint, eyes separated by a line beneath the antennæ; palpi white, proboscis short, brown; antennæ horizontal, yellow, no seta beneath, the third joint lanceolate, one-half longer than wide, the arista two and six-tenths times as long as the antennæ, its pubescence close and short. Thorax reddish yellow, the metanotum and rarely the scutellum brown, hairs very sparse, two rows of two acrostichals, only four hairs in the dorsocentral rows. Sides of middle abdominal segment with flattened setulæ; hypopygium black, nearly bare. Hind tibiæ with two extensor bristles trisecting its length, the terminal spur long and sharp. Halteres yellow. Wings clear hyaline, veins narrow, light brown, marginal cell moderately long, the second, third and fourth sections of the costa proportioned 1 : 1.8 : 1, the third and fourth veins straight, uniformly and slightly diverging, the first posterior cell widest at the apex, the anterior cross-vein at the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 3, of the fifth vein, 1.8 : 1.

Forty specimens, collected by August Busck for the U. S. National Museum in various places in the Canal Zone of Panama.

Elaphropeza nigricans sp. nov.

♂. Length 1.7 mm. Near *tenera* but with longer antennæ, shorter arista and more hairy body. Front narrowly V-shaped, at the bottom one-third as wide as the second antennal joint; ocellar and vertical bristles long and blackish; antennæ black, the second joint without long seta, the third joint lanceolate, twice as long as wide, the terminal arista scarcely longer than the antennæ, short-pubescent; eyes nearly contiguous below the antennæ; palpi white, and with a few white hairs; proboscis short and brown. Thorax polished black, but uniformly covered with long, black hairs, forming four rows of acrostichals with about eight hairs to each row, prescutellar and scutellar pairs of bristles long and black. Abdomen shining black, the sides of the middle segment with many scale-like setulæ; hypopygium minute. Legs yellow, the outer third of hind femora brown, hind tibiæ with two extensor bristles and with a very short and blunt apical spur. Halteres whitish; calypteres with five dusky hairs. Wings clear hyaline, veins narrow but dark, the second, third and fourth sections of the costa proportioned

1.5 : 2 : 1, the third and fourth veins straight, very slightly divergent, the last two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2.5 : 1, hairs of hind margin short.

One specimen: Corazal, Canal Zone, Panama, March. Collected by August Busck for the U. S. National Museum.

Elaphropeza pleuralis, sp. nov.

Length 2 mm. Robust, yellow species marked with black, hairs and bristles yellow. Occiput polished black, the occipital bristles longer than the ocellar; front very narrow, its sides converging below, at the bottom one-fourth as wide as the second antennal joint, eyes almost contiguous below the antennæ; palpi pale yellow and with a few yellow hairs, proboscis luteous; antennæ horizontal, pale yellow, the second joint with a circle of setulæ but without seta beneath, third joint short-lanceolate, one and one-half times as long as wide, the terminal arista pubescent, two and one-half times as long as the antenna. Thorax luteous, marked with a black, prescutellar spot, which is round in front and includes the scutellum and metanotum behind, a round prealar spot on the mesopleuræ, encroaching on the sternopleura; mesonotal hairs sparse, two rows of four acrostichals, a pair each of prescutellar and scutellar bristles. Abdomen yellow, not chitinized except the black middle segment and the narrow one following, sides of these segments with many flattened black setulæ; last tergite fringed with hairs, hypopygium small, elongate, rather hairy. Legs yellow, the last tarsal joint black, only the middle femora with preapical bristle, spur of the hind tibiæ long, blunt, brown, two extensor bristles on the hind tibiæ, one at the middle and one half-way to the knee. Halteres whitish, calypteres dark, with seven brown cilia. Wings clear hyaline, veins thin and brown, the second, third and fourth sections of the costa proportioned 1.5 : 2.5 : 1, the third and fourth veins parallel, the submarginal cell at the end of the first vein one-half as wide as the marginal and at the end of the second vein equal to the first posterior, last two segments of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2.5 : 1, marginal cilia short.

Four specimens: Alhajuelo, Panama, and Orizaba, Vera Cruz; from the U. S. National Museum.

Elaphropeza plumea, sp. nov.

♀. Length 2.2 mm. Robust shining yellow species with black occiput and heavily pubescent arista, discal cell large. Front very narrow, almost linear, shining black, face linear and black, occiput finely gray pollinose, cheeks and proboscis yellow, palpi large and white, epistome white pollinose; vertical bristles black; antennæ yellow, the second joint with uniform setulæ, the third joint ovate, one-half longer than broad, the blackish arista including its dense hairs appearing as thick as one-half the diameter of the third joint. Thoracic hairs moderately dense, the bristles yellowish; tip of the scutellum, center of the metanotum and a prescutellar spot brown. Middle segment of the abdomen brown and with flattened lateral setulæ. Legs slender, flexor hairs of the front femora long and yellow, middle tibiæ armed within with two rows of minute hook-like black setulæ, the apex angulate and black, hind tibiæ with two extensor bristles located before the basal third and beyond the apical third, the apical lappet sharp and rather strong. Halteres yellow. Wings narrow, more than three times as long as wide, veins yellow, second, third and fourth sections of the costa proportioned 1 : 1.3 : 0.6, third and fourth veins nearly straight and parallel, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 2.5 : 1.

One specimen: Orizaba, Mexico (H. H. Smith); in author's collection.

Elaphropeza rectineura, sp. nov.

Length 1.6 mm. Robust, yellow species, with pale hairs and bristles, last tarsal joint blackish. Head black, front narrow, the sides slightly converging below, at the bottom one-third as wide as the second antennal joint, ocellar bristles long, eyes contiguous beneath the antennæ; palpi white, proboscis short, yellow; antennæ yellow, the second joint without seta, the third joint broadly lanceolate, scarcely twice as long as broad. Thorax loosely hairy, two rows of six acrostichals, scutellum yellow, with lateral bristle one-fourth as long as the apical pair, metathorax yellow. Abdomen brownish yellow in the middle segments, where laterally there are many minute flattened setulæ. Middle femora alone with preapical setulæ, hind tibiæ with two long extensor bristles trisecting its length, the apical spur short and blunt. Halteres yellow, calypteres with five cilia. Wings clear hyaline, rather broad and rounded, marginal cilia short, the second, third and fourth sections of the costa proportioned 1 : 2 : 1, the third and fourth veins nearly straight, uniformly but slightly diverging, the first posterior cell widest at its apex, anterior cross-vein before the middle of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2 : 1.

Two specimens: Tabogal and Corazal, Panama, collected by August Busck for the U. S. National Museum.

Elaphropeza seminigra, sp. nov.

♂. Length 2.5 mm. Partly testaceous yellow and partly black. Occiput black, the upper orbits largely shining, the remainder pollinose, ocellar bristles brown, reaching to the antennæ, vertical bristles long and black; front very narrowly triangular; antennæ yellow, the third joint but slightly longer than deep, its blackish arista three times the length of the antenna proper, closely and evidently pubescent; palpi yellow, proboscis tipped with black. Thorax shining, the mesonotum broadly yellow about the shoulders, medially black, the dark coloring extending from side to side at the wings, bristles and hairs long and yellow, four rows of scattered acrostichals; scutellum and metanotum black, the apical pair of scutellar bristles approximate, long and cruciate;

pleuræ irregularly marked with black and reddish yellow, the mesopleuræ blackened except toward the coxæ. Abdomen yellowish, the middle and apical segments black, scales of the middle segment prominent on a gray velvety setting, abdominal hairs yellow. Legs yellow, the tarsi becoming dusky at the apex, front legs devoid of setulæ, middle femora and tibiæ with close-set rows of black setulæ, anterior femora with a long basal, yellow bristle underneath, hind tibiæ with a single black extensor bristle at two-fifths its length, the apical spur blackened, curved and pointed. Halteres pale yellow. Wings yellowish hyaline, their roots yellow, veins brown, costal sections proportioned 4 : 1.5 : 2.5 : 1, third and fourth veins parallel toward the end, anterior cross-vein at middle of the second basal cell, posterior cross-vein at the middle of the wing, sections of the fifth vein 2 : 1, costal hairs conspicuous.

Two specimens: San Jose, Costa Rica, March, 1915, received from Dr. A. H. Sturtevant.

Elaphropeza simplicipes, sp. nov.

Length 1.5 mm. Yellow, head cinereous black, scutellum, metanotum, middle segment of the abdomen and a vague prescutellar spot blackish, antennæ, mouthparts and legs yellow, middle tibiæ of the male with microscopic denticles within, of the female without denticles. Front narrow, shining, its sides nearly parallel, face linear, white-pollinose, vertical bristles brownish, third antennal joint conical, one-half longer than broad, the arista microscopically pubescent, about two and one-third times the antennal length. Mesonotum with sparse hairs, its bristles yellow; lateral setulæ of the middle segment of the abdomen flattened; upper valve of the brownish pygidium rounded and sericeous, the apical fringes short. Legs rather slender and short, front femora without black setæ, the two extensor bristles of the hind tibiæ close together, the apical spur moderate, yellowish, velvety and rather acute, last tarsal joint not dark. Wings less than three times as long as broad, veins yellow and thin, second, third and fourth sections of the costa proportioned 1 : 1.7 : 1, third and fourth veins straight and slightly diverging, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 1 : 0.4.

Montego Bay and Balaklava, Jamaica. Type in the Boston Society of Natural History.

A male specimen from Victoria, Texas, in the U. S. National Museum, is associated here. It is larger, measuring two millimeters, has the outer antennal joint dark, the metanotum reddish and the last tarsal joint dusky. Although phyletically it probably represents a distinct species the visible differences are too slight to utilize.

Elaphropeza tenera, sp. nov.

Length 1.5 mm. Polished black of a brownish tinge, hairs very sparse and pale. Front narrow, the sides nearly parallel, at the bottom less than one-half the width of the second antennal joint; ocelli minute, the ocellar bristles long; eyes nearly touching below the antennæ; palpi broad, white, with a couple of white bristles, proboscis yellow; antennæ short, yellow, the last joint short-lanceolate, one and one-half times as long as wide, the arista three times the antennal length, microscopically pubescent. Hairs of middle abdominal segment strong, but not scale-like in the Trinidad specimen; hypopygium small. Legs including the coxæ pale yellow, slender, the front trochanters with a black dot, apex of hind tibiæ blackish in the Trinidad specimen, middle femora alone with preapical bristle, hind tibiæ with two extensor bristles, the outer one small, the apical spur long and thumb-like. Halteres whitish; calypteres with four pale cilia. Wings clear hyaline, veins pale, the third section of the costa one and one-half times either the second or fourth section, the third and fourth veins straight, slightly diverging, the last two sections of the fourth vein proportioned 1 : 4, of the fifth vein, 2 : 1, wing margin ciliate.

Two specimens. Porto Bello, Panama, March 13, 1911, in the collection of the U. S. National Museum, and Montserrat, Trinidad Island, June 29, both collected by August Busck.

Elaphropeza uniseta, sp. nov.

♀. Occiput black, lightly pollinose, a spot on each side of the vertex shining, ocellar and vertical bristles short and black; front very narrow, linear, eyes subcontiguous beneath the antennæ; palpi and proboscis yellow, the palpi with scattered blackish hairs; antennæ horizontal, brown, the third joint triangular, twice as long as deep, the blackish arista slender, microscopically and closely pubescent, twice as long as the antennæ. Thorax shining reddish yellow, mesonotum with a median vitta abbreviated behind, and with a spot above the notopleural suture dark brown, center of the scutellum and the inflated sides of the first abdominal segment also brown; abdomen weakly chitinized except the middle segment whose sides are thickly studded with black scale-like setulæ; hairs of the thorax fine, dark, confined to the anterior region, comprising a few posthumeral and four definite rows of acrostichals with about five hairs to each row; presutural dorsocentral long, scutellum with two long cruciate bristles. Legs including the coxæ yellow, a little dusky distally, anterior femora with basal hair below, middle femora with a strong preapical bristle, hind tibiæ with a single strong extensor bristle located below the middle and with a broad blunt apical spur. Knob of halteres blackish; calypteres small but with a fan-like fringe of dark cilia. Wings hyaline, veins yellow, first vein ending beyond the middle, third section of the costa about three times either the second or the fourth section, marginal cell at the end of the first vein nearly twice as wide as the submarginal, the latter at the end of the second vein as wide as the first posterior cell, third vein lightly sinuous, converging with the fourth on its outer portion, anterior cross-vein before the middle of the second basal cell, the outer two sections of the fourth vein proportioned 1 :2, of the fifth vein, 3 : 1, costa with a basal hair, but not long ciliate, hairs of the posterior margin of the wings very short.

One specimen: Manila, Philippine Islands, Robert Brown, collector, in the U. S. National Museum.

Elaphropeza upsilon, sp. nov.

♂. Length 1.5 mm. Largely yellow with yellow legs and antennæ, the posterior part of the mesonotum marked with a broad U-shaped mark, hind tibiæ with a single extensor bristle located just before its middle, middle tibiæ microscopically denticulate along the flexor side. Head black, occiput pollinose up to the eyes, face linear, white-pollinose; mouthparts yellow; third antennal joint short-ovate, the arista less than three times as long as the antennæ and microscopically pubescent; vertical and ocellar bristles yellow. Hairs of the mesonotum rather sparse and long, bristles yellow; the black mark fills the posterior half of the mesonotum except in the middle and except the postalar callus; scutellum, metanotum and middle segment of the abdomen black, the middle segment of the abdomen with scale-like setulæ along the sides; pygidium brown, glabrous except the marginal fringe. Hind tibiæ with a moderate, acute, yellow, velvety, terminal lappet. Veins brown, second and third sections of the costa nearly equal, third and fourth veins nearly parallel, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 1 : 0.4.

Jamaica (Brues). In author's collection.

Elaphropeza vittata, sp. nov.

♀. Length 1.8 mm. Robust, yellow marked with black. Occiput black, lightly pollinose, its bristles and the ocellars pronounced; front linear, its sides parallel, eyes separated below the antennæ by a dense row of microscopic white hairs; palpi white and with white hairs, proboscis yellow; antennæ destroyed. Thorax polished reddish yellow, marked with a black vitta which is broadest behind and there includes the scutellum and metanotum and meets a black pleural vitta. The median vitta is not sharply bounded, the pleural vittæ fill the meso- and meta-pleuræ. The thoracic hairs are rather long and isolated, two rows of six acrostichal hairs, a pair each of prescutellar and scutellar bristles. Abdomen pale yellow, only the middle segment fully chitinized, the basal segments with only small lateral sclerites, the sides of the middle segment with many glistening scale-like setulæ. Legs yellow, the anterior tibiæ and all of the tarsi a little brownish, anterior femora with a moderate preapical bristle, hind tibiæ with two strong extensor bristles trisecting their length, their terminal spur long and sharpened, pale brown. Halteres white; calypteres ciliate with five brown hairs. Wings clear hyaline, veins yellow, third section of the costa nearly twice as long as the second or fourth, third and fourth veins parallel at the end, anterior cross-vein before the middle of the second basal cell, outer sections of the fourth vein proportioned 1 : 2.5, of the fifth vein, 3 : 1, hind margin with short cilia.

Type specimen from the U. S. National Museum, labeled "on pineapple," Lemon City, Florida, April 12, 1899. A defective specimen from Havana, Cuba, (Dr. A. H. Sturtevant), is apparently the same, differing in that the pleural blackening is less pronounced.

Bibliographic List of the Species of *Drapetis*.

A. Subgenus *Drapetis* Meigen, sens. str.

aliternigra, new name .... North America
nigra Melander, not Meigen, Tr. Am. Ent. Soc. xxviii. 208, f. 12, 17, 24 (1902). Lundbeck, Dipt. Dan. iii. 257, note (1910).

assimilis Fallen .... Europe
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minima Meigen, not Zetterstedt, B. S. vii. 100 (1838).
nigra Meigen, S. B. vi. 344 (1830); Curtis, Brit. Ent. viii. 397 (1832); Macquart, Suit. a Buff. i. 358 (1834); Walker, List, iii. 511 (1849) occ. in Canada; Walker, Ins. Brit. i. 136 (1851).
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? ambigua Macquart, Dipt. France iii. 94 (1827) *Platypalpus;* Suit. Hist. Nat. i. 351 (1834); Schiner, F. A. i. 92 (1862).
? curvipes Meigen, Syst. Bes. iii. 75 (1822) *Tachydromia.*
exilis Macquart, part Dipt. France iii. 88 (1827).
fascipes Roser, Wurttemb. Correspbl. i. 54 (1840).
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luteipes St. Fargeau and Serville.......... France
St. Fargeau and Serville, Encycl. Method. x. 437 (1825).

marginata Meigen.......... E. Europe
Meigen, Syst. Bes. vii. 100 (1838).

medetera Melander.......... W. United States
Melander, Trans. Am. Ent. Soc. xxviii. 208, pl. v. f. 22 (1902); Coquillett, Proc. Ent. Soc. Wash. v. 265 (1903) *Elaphropeza;* Melander, Ent. News, xvii, 372 (1906); Bezzi, Ann. Mus. Nat. Hung. v. 567 (1907) *Elaphropeza*.

moriella Zetterstedt .... N. and C. Europe
Zetterstedt, Ins. Lapp. 552 (1838) *Tachydromia;* Dipt. Sc. i. 299 (1842) *Tachydromia;* Wahlgren, Ent. Tidskr. xxxi. 86, f. 15 (1910).
curvinervis Zetterstedt, Dipt. Sc. i. 301 (1842) *Tachydromia.*
flexuosa Loew, Progr. Posen, 1840, 23; Isis vii. 552 (1840); Scholz, Zts. Ent. Bresl. v. (19) 60 (1851); Loew Neue Beitr. vi. 39 (1859); Schiner, F. A. Dipt. i. 96 (1862).
geniculata Fallen, Empid. 7, part (1815) *Tachydromia.*
nigra Zetterstedt, Dipt. Sc. i. 297 (1842) *Tachydromia;* Bonsdorf, Finl. tv. Ins. i. 150 (1861) *Tachydromia.*
picipes Zetterstedt, Dipt. Sc. i. 298 (1842) *Tachydromia.*

var. **setigera** Loew
Loew, Neue Beitr. vi. 39 (1859); Schiner, F. A. Dipt. i. 96 (1862); Lundbeck, Dipt. Dan. iii. 255, f. 114 (1910); Frey, Acta Soc. Fenn. xxxvii (3) 70 (1913).

var. **dilutipes** Strobl .... Spain
Strobl, Mem. Soc. Esp. Hist. Nat. iii. 312 (1906).

nitens, new species .... Mexico, Panama

nuda, new species .... Africa

obscuripennis Philippi, not Bezzi .... Chile
Philippi, Verh. z. b. Ges. Wien. xv. 768 (1865); Bezzi, N. Act. Kais. Akad. xci. 397 (1909).

œdimera, new species .... Vera Cruz

parvicornis, new species .... Washington

pennescens, new species .... Peru

phæoptera Bezzi .... N. Guinea
Bezzi, Wien. Ent. Ztg. xxiii. 145 (1904); Ann. Mus. Hung. x. 479 (1912).
obscuripennis Bezzi, not Philippi, Ann. Mus. Nat. Hung. ii. 351 (1904).

pilipes Loew .... S. Europe, N. Africa
Loew, N. Beitr. vi. 36 (1859); Bezzi, Bull. Soc. Ent. Ital. xxx. 152 (1899); Becker, Mittl. Zool. Mus. Berl. ii. 40 (1902).

plumipes, new species .... Texas

pubicornis Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 479 and 482 (1912).

quadrisetosa, new species .... Mexico, Central America

scissa, new species .... W. United States
medetera Melander, part, Tr. Am. Ent. Soc. xxviii. 208, pl. 5, f. 22 (1902); Coquillett Proc. Ent. Soc. Wash. v. 265 (1903) *Elaphropeza*; Melander, Ent. News. 372 (1906); Bezzi, Ann. Mus. Hung. v. 567 (1907) *Elaphropeza.*

septentrionalis Melander .... Michigan
Melander, Tr. Am. Ent. Soc. xxviii. 211 (1902).

var. **mexicana,** new variety .... Tampico

spectabilis Melander .... United States
Melander, Tr. Am. Ent. Soc. xxviii. 212, f. 9, 20 (1902).

spinipes, new species .... Africa

unipila Loew .... W. United States
Loew, Berl. Ent. Zeitschr. xvi. 88, Cent. x. 60 (1872); Melander, Tr. Am. Ent. Soc. xxviii. 211 and 339, f. 10, 14, 21 (1902); Ent. News, xvii. 372 (1906).

var. **nitida** Melander .... W. United States
Melander, Tr. Am. Ent. Soc. xxviii. 207, f. 10, 14, 21, and 339; Cole, Rept. Laguna Marine Lab. i. 152 (1912).

vitiosum Meunier .... Baltic Amber
Meunier, Ann. Sci. Nat. Zool. 7, 96, pl. iii. f. 10–13 (1908)

xanthopoda Williston part .... West Indies
Williston, Tr. Ent. Soc. Lond. iii. 308, pl. iv. f. 85, part (1896); Melander, Tr. Am. Ent. Soc. xxviii, 212 and 340 (1902).
flavipes Williston, not Macquart, Tr. Ent. Soc. Lond. iii. Appendix, 441, table (1896); Melander, Tr. Am. Ent. Soc. xxviii. 212 (1902).

C. Subgenus *Ctenodrapetis* Bezzi.

aristalis, new species.......Philippine Islands

ciliatocosta Bezzi.......Australia, South America
Bezzi, Ann. Mus. Nat. Hung. ii. 355, f. 6 (1904); N. Act. Kais. Akad. xci. 397 and 400 (1909); Ann. Mus. Hung. x. 481 (1912).

cuneipennis, new species.......Philippine Islands

discoidalis Bezzi.......E. Indies
Bezzi, Ann. Mus. Nat. Hung. ii. 355 (1904); x. 482 (1912).

gracilis Bezzi.......N. Guinea
Bezzi, Ann. Mus. Nat. Hung. ii. 354 (1904); x. 480 (1912).

hamifera Bezzi.......Formosa
Bezzi, Ann. Mus. Hung. x. 479 and 485 (1912).

monochæta Bezzi.......Peru
Bezzi, N. Acta. Kais. Akad. xci. 401 (1909).

rubrithorax Bezzi.......N. Guinea
Bezzi, Ann. Mus. Nat. Hung. ii. 356 (1904); x. 482 (1912).

strigifera Meijere.......Java
Meijere, Tijdschr. Ent. Liv. 333 (1911); lvi. suppl. 75 (1914).

valdiviana Philippi.......Chile
Philippi, Verh. Ges. Wien. xv. 768 (1865) *Drapetis;* Bezzi, N. Act. Kais. Akad. xci. 397 (1909) *?Ctenodrapetis.*

D. Subgenus *Elaphropeza* Macquart.

abdominalis Wiedemann.......China
Wiedemann, Aussereurop. Ins. ii. 12 (1830) *Tachydromia;* Bezzi, Ann. Mus. Hung. ii. 359, note (1904) *Tachydromia;* Melander, Psyche, xvii. 52 (1910) *Ctenodrapetis.*

antennata Becker.......E. Africa
Becker, Bul. Mus. Paris 115 (1909); Ann. Soc. Ent. Fr. lxxix. 24 (1910); Bezzi, Ann. Mus. Hung. x. 481 (1912).

Bacis Walker.......Jamaica
Walker, List. Dipt. Ins. iii. 510 (1849) *Platypalpus;* Coquillett, Proc. U. S. Mus. xviii. 439 (1896) *Tachydromia;* Melander, Tr. Am. Ent. Soc. xxviii. 226 (1902) *Tachydromia;* Bezzi, Ann. Mus. Hung. iii. 460 (1905) *Tachypeza;* N. Act. Kais. Akad. xci. 402, note (1909); Melander, Psyche, xvii. 52 (1910) *Ctenodrapetis.*

basalis Bezzi.......Ceylon
Bezzi, Ann. Mus. Hung. ii. 349 (1904); v. 567 (1907); x. 479 (1912).

bicolor Bezzi.......N. S. Wales
Bezzi, Ann. Mus. Hung. ii. 349 (1904); v. 567 (1907); x. 482 (1912).

bicoloripes Brunetti.......E. Himalayas
Brunetti, Rec. Ind. Mus. ix. 43 (1913).

bihamata Bezzi.......N. Guinea
Bezzi, Ann. Mus. Nat. Hung. ii. 353 (1904) *Drapetis.*

binotata Meijere.......Java
Meijere, Tijdschr. Ent. Liv. 333 (1911) *Drapetis*; lvi. suppl. 75 (1914).

calcarifera Bezzi.......Formosa
Bezzi, Ann. Mus. Hung. v. 267 and 268 (1907); x. 481 and 488 (1912).

callositibia Bezzi.......N. Guinea
Bezzi, Ann. Mus. Nat. Hung. ii. 354 (1904) *Drapetis;* x. 480 (1912) *Drapetis.*

calva, new species.......Panama

comata, new species.......Trinidad

dispar Adams .... Rhodesia
Adams, Kans. Univ. Sci. Bul. iii. 157 (1905); Bezzi, Ann. Mus. Hung. v. 567 (1907); x. 480 (1912).

ephippiata Fallen .... Europe
Fallen, Empid. 11 (1815) *Tachydromia;* Meigen, Syst. Bes. iii. 65, pl. 23, f. 10 (1822) *Hemerodromia;* Macquart, Dipt. Nord. Fr. iii. 87, pl. 2, f. 1 (1827); Hist. Nat. i. 359, pl. 8, f. 14a (1834); Zetterstedt, Dipt. Sc. i. 326 (1842); Boitard, Nouv. Man. iii. 325 (1843); Walker, List. iii. 505 (1849); Ins. Saunders. i. 134, pl. 5, f. 4 (1851); Scholz, Zts. Ent. Bresl. v. 60 (1851) (*ephippium*); Schiner, F. A. Dipt. i. 95 (1862); Strobl, Mitth. Steierm. xxix. 127 (1892); Melander, Ent. News, xvii. 372 (1906) *Drapetis;* Bezzi, Ann. Mus. Hung. v. 567 (1907); Lundbeck, Dipt. Dan. iii. 273, f. 123, 124 (1910); Wahlgren, Ent. Tidskr. xxxi. 89 (1910); Bezzi, Ann. Mus. Hung. x. 482 (1912); Frey, Acta Soc. Fenn. xxxvii. (3) 75 (1913).
? maculata Macquart, Mem. Soc. Sci. Lille, 153 (1823) *Tachydromia.*

exul Osten Sacken .... Philippine Islands
Osten Sacken, Berl. Zts. xxvi. 113 (1882); Bezzi, Ann. Mus. Hung. ii. 347; (1904); v. 567 (1907); x. 480 (1912) *Drapetis.*

ferruginea Brunetti .... India
Brunetti, Rec. Ind. Mus. ix. 43 (1913).

flavicollis Becker .... E. Africa
Becker, Bull. Mus. Paris 116 (1909) *Drapetis;* Ann. Soc. Ent. Fr. lxxix. 24 (1910) *Drapetis;* Bezzi, Ann. Mus. Hung. x. 482 (1913).

flavida Williston .... W. Indies, C. and S. America
Williston, Trans. Ent. Soc. Lond. iii. 308, pl. 11, f. 86 (1896) *Drapetis;* Coquillett, Proc. U. S. N. Mus. xxii. 251 (1900) *Tachydromia;* Wheeler & Melander, Biol. C. Am. Dipt. i. 376 (1901) *Drapetis;* Melander, Mon. Empid. 213 (1902) *Drapetis;* Coquillett, Proc. Ent. Soc. Wash. v. 265 (1903) *Tachydromia;* Bezzi, N. Act. Kais. Akad. xci. 397 and 398 (1909) *Drapetis;* Melander, Psyche, xvii. 52 (1910) *Ctenodrapetis;* 1910; Bezzi, Ann. Mus. Hung. x. 481 (1912).
fulvida Bezzi, Wien. Ent. Ztg. xxiii. 144 (1904) *Tachista.*
xanthopoda Williston part, Tr. Ent. Soc. Lond. iii. Appendix, 441, table (1896) *Drapetis.*

formosæ Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. v. 566 (1907); x. 480 and 487 (1912).

fulvithorax v. d. Wulp .... Ceylon
Wulp, Termes, Fuzet. xx. 138 (1897); Tijdschr. Ent. xlii. 49 (1899); Bezzi, Ann. Mus. Hung. ii. 347 (1904); v. 567 (1907); x. 480 (1912); Meijere, Tijd. Ent. lvi. suppl. 73 (1914).

hirsutitibia Meijere .... Java
Meijere, Tijd. Ent. lvi. suppl. 73 (1914).
bihamata Meijere, not Bezzi, Tijd. Ent. liv. 332 (1911) *Drapetis.*

inflexa, new species .... Panama

Kerteszi Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 481 and 486 (1912); Meijere, Tijd. Ent. lvi. suppl. 74 (1914).

læta, new species .... Panama
var. **nigrocalcarata,** new var .... Panama
var. **ungulifera,** new var .... Panama

lanuginosa Bezzi .... Formosa
Bezzi, Suppl. Entom. iii. 75 (1914).

lineola Meijere .... Java
Meijere, Tijdschr. Ent. liv. 331 (1911); lvi. suppl. 75 (1914).

lutea Meijere .... Java
Meijere, Tijdschr. Ent. liv. 332 (1911); lvi. 76 (1914).

luteicollis, new species .... Panama

marginalis Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 481 and 489 (1912).

melanura Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 481 and 489 (1912).

metatarsata Bezzi .... Ceylon
Bezzi, Ann. Mus. Hung. ii. 348 (1904); v. 567 (1907); x. 482 (1912).

nigricans, new species .... Panama

obliquinervis Meijere .... Java
Meijere, Tijd. Ent. suppl. 73, pl. 2, f. 9 (1914).

palpata Meijere .... Java
Meijere, Tijdschr. Ent. liv. 330 (1911); lvi. suppl. 76 (1914).

pictithorax Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 482 and 486 (1912).

pleuralis, new species .... Vera Cruz, Panama

plumea, new species .... Mexico

rectineura, new species .... Panama

scutellaris Bezzi .... Formosa
Bezzi, Ann. Mus. Hung. x. 481, 482, 487 (1912).

seminigra, new species .... Costa Rica

simplicipes, new species .... W. Indies

spuria Bezzi .... N. Guinea
Bezzi, Ann. Mus. Hung. ii. 347 (1904); v. 567 (1907); x. 480 (1912).

tenera, new species .... Trinidad, Panama

uniseta, new species .... Philippine Islands

upsilon, new species .... W. Indies

variata, new name .... India
variegata Brunetti (bis) Rec. Ind. Mus. ix. 42 (1913).

variegata Brunetti .... Burma
Brunetti, Rec. Ind. Mus. ix. 39 (1913) *Drapetis*.

vittata, new species .... Florida

xanthocephala Bezzi .... Formosa
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